Specialist's Report-Fire/Fuels

Project Name: Mud Creek Project
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Introduction

The West Fork Ranger District of the Bitterroot National Forest is proposing vegetation management, fuels reduction, and watershed improvements on National Forest System lands in the West Fork of the Bitterroot River. The proposed vegetation and fuels management components of the Mud Creek Project include a combination of regeneration treatments, intermediate treatments, non-commercial activities and various types of prescribed fire. Refer to the fuels prioritization and process document (PF-FIRE-002).

Table 1: (Proposed Action-Maximum Acres by Activity)

Commercial Harvest (Regeneration)	Commercial Harvest (Intermediate)	Non-commercial activities	Prescribed Fire- Site Preparation	Prescribed Fire- Low Severity	Prescribed Fire- Mixed Severity
4,800	8,900	26,282	4,800	28,235	12,125

The proposed treatments would reduce the potential of crown fire behavior in low and mixed severity fire regimes within the Wildland Urban Interface and Community protection zone, and improve forest resilience to natural disturbances by modifying forest structure and composition, and fuels. The project also proposes road improvements, storage and decommissioning of roads to improve watershed and fisheries conditions by reducing sediment sources and construct motorized trail to increase recreational opportunities.

The Mud Creek Project area is approximately 48,486 acres, south of Conner, Montana and is administered by the West Fork Ranger District, Bitterroot National Forest in Ravalli County. Major drainages within the project area include Little West Fork, Nez Perce Fork, Tough, Two, Beavertail, Rombo, Mud, Took and Blue Joint, all of which drain into the West Fork of the Bitterroot River.

The purpose and need for the project area is:

- Improve landscape resilience to disturbances (such as insects, diseases, and fire) by modifying forest structure and composition, and fuels. The departure from historic fire regimes within the project area has created forest stands characterized by high stem densities, hazardous fuels build up, stressed tree condition, and a loss of meadow habitat area and quality. The results are forest stands with high surface and ladder fuels, susceptibility to uncharacteristic fire behavior, and at risk to future insect outbreaks. Meadow habitats are experiencing a reduction in size through conifer encroachment and quality through lack of fire necessary to stimulate forbs and grasses.
    - There is a need to reduce crown fire hazard potential within the Wildland-Urban Interface, adjacent community protection zone and low severity fire regimes.
    - There is a need to reduce stand densities, increase age class diversity and favor shade intolerant species to promote resilience to stressors (e.g. drought, insects, and diseases).
    - There is a need to improve habitat and forage quality and quantity for bighorn sheep,

mule deer, elk, and other regionally sensitive species.

- Design and implement a suitable transportation and trail system for long-term land management that is responsive to public interests and reduces adverse environmental effects. The project area currently has one of the highest road densities found on the Bitterroot National Forest. Field surveys have identified some road segments in need of maintenance and repair to address resource concerns (e.g. watershed health). Some third order drainages currently exceed Bitterroot Forest Plan road density standards for elk habitat effectiveness. And opportunities exist to designate new motorized and non-motorized trails and make on-the-ground conditions compatible with road travel status in the Bitterroot Travel Management Plan.
    - There is a need to implement road improvements and BMPs to address chronic sediment sources to improve water quality and fish habitat.
    - Where road segments are not needed for future management, there is a need to decommission road segments to reduce road densities and improve elk security.
    - There is a need to address discrepancies (e.g. gated roads designated as open) between on the-ground road conditions and travel status in the Bitterroot Travel Management Plan.
    - There is a need to provide for additional recreational opportunities, by creating motorized and non-motorized trail opportunities when resource concerns can be mitigated

This analysis describes the existing condition of the fire/fuels condition within the project area and discloses the potential effects of the No Action and Proposed Action on fuels conditions and fire behavior for consideration in preparing a Finding of No significant Impact and determining whether or not to prepare an environmental impact statement.

Overview of Issues Addressed

The following issues were identified from external scoping of the project:

Fuel Treatment Effectiveness: Proposed wildland fuel reduction work may be inefficient and ineffective at changing fire behavior and in reducing home losses due to fire. Proposed treatments such as logging, thinning and road building have the potential to exacerbate the severity of subsequent wildfires. Post treatment effects on fire behavior will be addressed within this report. Reducing home loss from fire is a beneficial outcome but not the purpose and need of the project nor the sole intent of the proposed action.

This issue was considered by the ID team and Line Officer, but did not result in the development of additional project alternative. Findings and discussion regarding this concern are included in this report.

Criteria Used For Analysis

One of the purposes for proposing treatments within the project area is to reduce the potential for crown fire behavior within the Wildland Urban Interface, adjacent community protection zone and in low severity fire regimes. The measure to assess how well the No Action and Proposed Action meets the purpose and need is in the indicators below:

Indicators

***Flame length*:** Change in potential flame length (feet) for all proposed acres. Flame lengths generally less than 4 feet are desired, allowing for safe direct attack by handcrews. Flame lengths greater than 4 feet generally require equipment to be employed such as dozers and aircraft; beyond 8 feet torching, crowning and spotting can occur.

Fire type: Change in the potential fire type across the project area, measured as acres of surface fire versus crown fire.

Surface fire**-** Fire that burns loose debris on the surface, which include dead branches, leaves, and low vegetation. Burns only in the surface fuelbed.

Torching (passive) fire- consuming single or small groups of trees or bushes.

Crown fire- The surface fire ignites crowns and the fire spread is able to propagate through the canopy.

***Fire rate of spread*:** Change in potential fire rate-of-spread measured in chains per hour. The relative activity of a fire extending its horizontal dimensions. One chain equals 66 feet.

Methodology

LANDFIRE (www.landfire.gov) is a national vegetation and fuels mapping project that provides nationally consistent and seamless geospatial data products for use in wildland fire analysis and modeling. LANDFIRE national data for elevation, aspect, slope, fire behavior fuel model, canopy cover, canopy height, canopy base height, and canopy bulk density were used as the basis for geospatial wildland fire modeling. Together these geospatial data layers make up a “landscape” file that was used to run the fire behavior modeling in FlamMap. The outputs of this model were used for the effects analysis of this project. Additional LANDFIRE products for Fire Regime Groups, Vegetation Condition Class were also used during the analysis of this project.

LANDFIRE National data version 2012 was evaluated by forest staff and members of the Fire Modeling Institute during a June 2015 calibration workshop. Fuel rules, used within the LANDFIRE Total Fuel Change Tool (LFTFCT), were developed during this workshop for each major Existing Vegetation Type (EVT) based on local expertise with existing conditions, fuel models and fire behavior. These rules allow for national level LANDFIRE data to be calibrated for use at the forest scale. The ruleset also allows for changes to fuel models and canopy characteristics to be applied to the LANDFIRE data from recent disturbances such as fire or project implementation. Field reconnaissance of EVT’s, past fire and management disturbances as well as photo plots were used in combination with professional experience to develop the rules necessary to make adjustments to the data where needed. The fuels specialist used this calibrated data and LFTFCT rulesets for the Mud Creek analysis. Beyond the calibration, LANDFIRE data wasn’t adjusted for recent private land activities because of a lack of site specific disturbance information required to make accurate adjustments to the fuels data. Private and state lands only comprise 4% of the analysis area and contain no proposed activities as part of this project. There have been no large scale treatments or disturbances that would have a major change to the calibrated fuels in these areas. Fire behavior outputs for both the existing and proposed action remained the same. Analysis of the relative effects of the project activities were not affected by this lack of data.

ArcMap 10.5 and the FlamMap5 fire modeling system was used to assess the distribution of potential fire behavior characteristics in the planning area. Specific characteristics assessed were fireline intensity expressed as flame length in feet, fire type expressed as surface, passive crown or active crown fire and rate of spread expressed as chains/hour. Since environmental conditions remain constant when using FlamMap, it will not simulate temporal variations in fire behavior caused by weather and diurnal fluctuations. Nor will it display spatial variations caused by backing or flanking fire behavior. These limitations need to be considered when viewing FlamMap outputs using these models in an absolute rather than relative sense (USDA, 2020). FlamMap assumes that every pixel on the raster landscape burns and makes fire behavior calculations (e.g., fireline intensity, flame length) for each location (cell), independent of one another. That is, there is no predictor of fire movement across the landscape and weather and wind information can be held constant. By so doing, FlamMap output lends itself well to landscape comparisons (e.g., pre- and posttreatment effectiveness) and for identifying hazardous fuel and topographic combinations, thus aiding in prioritization and assessments (Stratton 2004).

Specification of Severe Burning Conditions

Historic fire weather was analyzed to determine wind and fuel moisture conditions during the fire season using FireFamilyPlus 4.2. Remote Automated Weather Stations (RAWS) collect fire weather that is archived and available through KCFAST (http://fam.nwcg.gov/fam-web/kcfast/mnmenu.htm) and the Western Region Climate Center (http://www.raws.dri.edu/index.html). Weather data used in this analysis is from the West Fork weather station (242907) and includes observations for the last 34 years (1986–2019) between the dates of June 1 through September 30. This time period represents the typical fire season for the Bitterroot National Forest when most wildfires occur. Weather and fuel moisture values used in the fire behavior modeling are displayed in Table 2 below and represent 97th percentile conditions (high severity fire weather and fuel moisture conditions).

Table 2: (97% Fuels/Weather Inputs used in Fire Modeling)

FUEL/WEATHER INPUT	SEVERE VALUE
1 hr fuel moisture	2%
10 hr fuel moisture	3 %
100 hr fuel moisture	7 %
1000 hr fuel moisture	10 %
Woody fuel moisture	70 %
Herbaceous fuel moisture	30 %
Foliar Moisture	100%
20-foot windspeed	8 mph
Wind Direction	245 degrees

Severe conditions can exist periodically throughout the fire season and have recently been a more prolonged event as experienced in the 2000, 2003, 2007, 2012 & 2017 fire seasons. During the 2012 fire season, Energy Release Component (ERC) values exceeded the 97% for all of September and early October and set records for most days during the last ten years. At the lower elevations and fuel types, even more normal conditions of higher fuel moistures and more moderate temperatures have the potential of producing fast moving crown fires that would be difficult to control.

Post treatment modeling was conducted assuming all proposed treatments have been applied. Fire behavior fuel models used in modeling were derived from Scott and Burgan (Scott, 2005) as a measure to display general changes in fuel profiles by vegetative cover type in the model. Fire behavior fuel models were adjusted over the project area to reflect the current and post-treatment conditions.

Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the No Action and Proposed Action, rather than as an indicator of absolute effects (Graham et al. 2004; Stratton 2006). Interpretation, professional judgment, and local knowledge of fire behavior were used to evaluate the outputs from the models and adjustments made as necessary to refine the predictions.

Spatial and Temporal Context for Effects

Spatial Bounds: The effects analysis is focused entirely within the project area boundary. This is considered adequate in size from which proposed treatments and past disturbances could influence fire behavior within the area. Cumulative effects also considered the adjacent WUI outside the project area.

Temporal Bounds: The timeframe considered is approximately 20 years in the future at which time the proposed treatment activities would be completed and vegetation and fuels response to those treatments stabilized.

Design Features and Mitigation Measures

- See Mud Creek design features (EA Appendix A) and Forest Plan consistency checklist for fuels related design features. Any required mitigation measures will be identified and applied during step 4 in the implementation plan (EA Appendix B).

Affected Environment

Regulatory Framework

National Level Direction

National Cohesive Wildland Fire Management Strategy (2010) [1]

In 2009, Congress passed the Federal Land Assistance, Management, and Enhancement Act (FLAME Act), which directs the U.S. Department of Agriculture (USDA) and the Department of the Interior (DOI) to develop a national cohesive wildland fire management strategy to comprehensively address wildland fire management across all lands in the United States.

The National Strategy recognizes and accepts fire as a natural process necessary for the maintenance of many ecosystems, and strives to reduce conflicts between fire-prone landscapes and people. By simultaneously considering the role of fire in the landscape, the ability of humans to plan for and adapt to living with fire, and the need to be prepared to respond to fire when it occurs, the Cohesive Strategy takes a holistic approach to the future of wildland fire management.

The Wildland Fire Leadership Council (WFLC) adopted the following vision for the next century:

To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.

[1] *For a full description and supporting reference material of the National Cohesive Strategy reference the website, https://www.forestsandrangelands.gov/strategy/*

The primary, national goals identified as necessary to achieving the vision are:

Restore and maintain landscapes: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.

Fire-adapted communities: Human populations and infrastructure can withstand a wildfire without loss of life and property.

Wildfire response: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

The Proposed Action would move the project area towards meeting the three National Cohesive Strategy goals. Reducing crown fire potential in warm dry forest types and restoring fire on the landscape would move conditions closer to the representative fire regimes, allowing the landscape to be more resilient to fire disturbances. By reducing fuels and changing fire behavior within the WUI and community protection zone, the Proposed Action moves the area closer to the goal of making fire adapted communities resilient to loss from wildfire. Lastly, these changes will improve wildfire response by providing less hazardous conditions for firefighters (reduced fire intensities, reduced hazard trees), increasing fire management options and success by creating continuous areas with reduced fuel loads and continuity. This will also increase opportunities for allowing natural fire to play its ecological role within the adjacent Selway-Bitterroot, Frank Church River of No Return Wildernesses and Blue Joint Wilderness Study Area.

Federal Wildland Fire Policy

The principal document guiding fire management on Federal lands is the 1995 Federal Wildland Fire Management Policy. The policy was endorsed and implemented in 1995. The 1995 Federal Wildland Fire Policy was reviewed and updated in 2001 (Review and Update of the 1995 Federal Wildland Fire Management Policy, 2001). In 2003 the Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy was approved. The 2003 Implementation Strategy was replaced in 2009 with the adoption of the Guidance for Implementation of Federal Wildland Fire Management Policy which states that:

> *"Fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, and across agency boundaries. Response to wildland fire is based on ecological, social and legal consequences of the fire. The circumstances under which a fire occurs, and likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected dictate the management response to fire".*

The Proposed Action complies with the Federal Wildland Fire Policy by considering fire's natural role within the ecosystem on a landscape scale and integrating fire into the project design. It also complies by proposing treatments that reduce hazardous fuels to modify current fire behavior improving firefighter and public safety and welfare and reducing the effects on values.

Federal Clean Air Act

Congress passed the Clean Air Act in 1963, and amended it in 1970, 1977, and 1990. The purpose of the act is to protect and enhance air quality while ensuring the protection of public health and welfare. The 1970 amendments established National Ambient Air Quality Standards (NAAQS), which must be met by most state and Federal agencies, including the Forest Service.

States are given the primary responsibility for air quality management. The Clean Air Act requires states to develop state implementation plans (SIP) that identify how the state will attain and maintain NAAQS. The Montana Clean Air Act promulgates the SIP and created the Montana Air Quality Bureau (now under the Department of Environmental Quality). The Clean Air Act also allows states, and some counties, to adopt unique permitting procedures and to apply more stringent standards. Montana MDEQ are advisors to the Idaho/Montana Airshed Group (which is comprised of the State and Federal resource management agencies and private companies with a history of prescribed fire use) to regulate smoke emissions through a burn approval process and monitoring program. MTDEQ retains the authority to recommend go/no-go decisions for burning in the fall. In the spring, this is done by the Airshed Group Smoke Coordinator. The Clean Air Act requires that Forest Service actions have “no adverse effect” on air resources by meeting the NAAQS and non-degradation standards for Class I areas. Managers are further directed to improve substandard existing conditions and reverse negative trends where practicable (e.g., Missoula is a “non-attainment” zone in need of improvement).

All prescribed fire burn plans will address mitigation measures to minimize smoke impacts and comply with the Clean Air Act. The Proposed Action is designed to meet the goals, objectives, and standards set forth by this law and the following local regulatory framework. By following the coordination requirements, implementation of the proposed activities would meet State Requirements of the State Implementation Plan and the Smoke Management Plan and Forest Plan standards for air quality. The proposed activities comply with the Federal Clean Air Act as it would not cause exceedances in NAAQS or impact Class 1 Airsheds.

Forest Service Manual and Handbook Direction

Forest Service Manual 5140: Gives specific direction on planning and implementation of all management-ignited fires. It requires that a detailed prescribed fire burn plan be prepared for each management-ignited prescribed fire. This burn plan describes burn objectives, quantifies acceptable results, assesses risk, and provides acceptable parameters, regarding weather, fuel and safety, which allows for ignition. Approved burn plans will comply with direction in the Interagency Prescribed Fire Planning and Implementation Procedures Guide (2017). All proposed prescribed fire treatments will have site specific burn plans that comply with Forest Service Manual 5140 direction and follow guidance within the Interagency Prescribed Fire Planning and Implementation Procedures Guide.

Forest Service Manual 2500: Watershed and Air Management provides direction and policy regarding air quality. It incorporates the Clean Air Act and amendments (42 U.S.C. 7401 et seq.). The Environmental Protection Agency issued air quality standards for “fine” particulate matter (PM 2.5) and ozone emissions effective September 16, 1997. The current standard for “coarse” particulates (PM – 10) was retained. In Montana, open burning season is permissible from March 1st through November 30th. The Smoke Monitoring Unit for Idaho/Montana regulates all open burning in the state. During open season, our burning is done in accordance with approval from the Department of Environmental Quality, County Health Department, and the Smoke Monitoring Unit. All prescribed burning would be implemented in full compliance with the MTDEQ air program with coordination through the Montana/Idaho Airshed Group.

Forest Service Manual 5130: Wildland Fire Suppression gives specific direction to safely suppress wildfires at minimum cost consistent with land and resource management objectives and fire management direction as stated in Fire Management Plans (FSM 5120; FSH 5109.17).

Title 17, Chapter 8, Subchapter 6 of the Administrative Rules of Montana (ARM) In compliance with ARM 17.8.610, the Forest Service obtains a major open burning permit annually from the State and agrees to utilize Best Available Control Technology (as defined in ARM 17.8.601(1)) and observe the provisions of the major open burning permit (PF-FIRE-003).

Fire Management Planning Guide: Forest Service Fire Management Plans (FMPs) will be replaced with a combination of enhanced Spatial Planning contained in the Wildland Fire Decision Support System (WFDSS) and the Fire Management Reference System (FMRS), a collection of plans required for fire program management, such as aviation, operations, dispatch, and fire danger operating plan products. Fire Management Planning will be a continuing effort to ensure that guidance represented spatially in WFDSS and the FMRS are consistent with Land and Resource Management Plan (LRMP) direction, reflecting available fire response options to move from current to desired conditions. The FS has replaced the FSH 5109.19 with a Fire Management Planning Guide that further describes Spatial Fire Planning and the Fire Management Reference System (FMRS). As allowed in the (LRMP), fire response strategies should be consistent with the Cohesive Strategy and developed in collaboration with adjoining land managers. This Guide is at http://fsweb.wo.fs.fed.us/fire/fmp/

Local Guidance

Bitterroot Community Wildfire Protection Plan

The National Fire Plan and the 10-year Cohesive Strategy were the impetus behind the Bitterroot Community-Based Wildland Fire Risk Mitigation Plan (Community Wildfire Protection Plan). All city, rural, and federal fire department Fire Chiefs in Ravalli County collaboratively developed and adopted the Community Wildfire Protection Plan. The County Commissioners and Bitterroot National Forest Supervisor signed the document. The Community Wildfire Protection Plan prioritizes hazardous fuels treatment locations on the Bitterroot National Forest as directed in the National Fire Plan.

The Mud Creek project area is one of several areas on the Bitterroot National Forest identified as high priority for fuel reduction work through the Bitterroot Community Wildfire Protection Plan (DNRC et al., 2006) http://dnrc.mt.gov/divisions/forestry/docs/fire-and-aviation/wui Priority setting was based primarily on forest and fuel conditions, population density, and buildings and other improvements. The Proposed Action would be responsive to the Bitterroot Community Wildfire Protection Plan goals and objectives that identified this area as a high priority for treatment to reduce fuels and the risk of wildfire to the community.

Bitterroot National Forest Land Management Plan

The Bitterroot National Forest Land Resource Management Plan (LRMP) (USDA Forest Service 1987) includes forest-wide fire management direction that is consistent with other resource goals (LRMP Appendix M-1). Direction provided in the LRMP, Appendix M, directs that fire programs be cost effective, compatible with the role of fire in ecosystems, and responsive to resource management objectives, including:

- Using prescribed fire to maintain healthy ecosystems that meet land management objectives.
- Maintaining an adequate cadre of well-qualified prescribed fire experts to apply both technical knowledge and field experience in accomplishing prescribed fire needs.
- Emphasizing fire ecology when applying prescribed fire, and using fire ecology reference documents.
- Attempting to integrate an understanding of fire's role in regulating stand structure into development of silvicultural prescriptions.
- Emphasizing the use of prescribed fire in range and wildlife habitat improvement projects.
- Permitting Wildland Fire Use (natural ignitions) to the extent possible within prescriptions that provide for protection of life, property, and adjacent resources.
- Maintaining prescribed fire programs that are responsive to national, state, and local air quality regulations and agreements.
- Ensuring an active "inform and involve" program to ensure public involvement, understanding, and approval of prescribed fire programs.

Fire is recognized as a valuable tool for reducing natural fuels and activity fuels generated from harvest operations. Fire treatments include broadcast burning, underburning, jackpot burning, and pile burning. These treatments have all been identified as necessary in fuels management. Prescribed fires can only occur when such fire management planning is fully integrated into Forest National Forest Management Act (NFMA) and NEPA analysis, objectives associated with the use of fire are defined and disclosed, fuels management is based upon ecosystem management principles, processes, and desired conditions, and the effects are analyzed at various scales (USDA Forest Service 1987, Appendix M). The following Forest Plan Management Areas are within the Mud Creek Project Area. The overall management goal and the specific fire management requirements for each management area are listed below.

Conditions after treatment will improve fire managers abilities to meet the Bitterroot National Forest Plan's fire management direction of protection within Management Areas 1, 2 & 3A and Fire Management Units 1 (WUI) and 2 (Roaded). Treatments would increase the ability to utilize wildfire in Management Areas 5 & 8A and adjacent Management Areas (6, 7B & 7C) that represent the Selway-Bitterroot, Frank Church River of No Return Wildernesses and Blue Joint Wilderness Study Area. The Proposed Action would meet the Bitterroot National Forest Plan direction of using prescribed fire to maintain healthy ecosystems and promote other plan objectives such as protection of timber values, protection and enhancement of wildlife habitat and protection of visual quality. The design features in the EA, Appendix A describe how activities will meet forest plan requirements.

Table 3. (Forest Plan Management Areas with Fire Management Direction)

MANAGEMENT AREA	MANAGEMENT AREA GOALS & FIRE MANAGEMENT DIRECTION
MA1 (11,835 acres 24%)	**Management Goal:** Emphasize timber management, livestock and big-game forage production, which provide an added benefit of access for roaded dispersed recreation activities and mineral exploration. Assure minimum levels for visual quality, old growth, and habitat for other wildlife species. **Fire Management Requirement:** Fire planning will be designed to protect and enhance timber investments and values. Prompt control action will be taken on all wildfires. All types of fire suppression equipment may be used. (LRMP, Ch. III pp. III-3, III-7)

MA2 (14,650 acres 30%)	**Management Goal:** Optimize elk winter range habitat using timber management practices. Emphasize access for mineral exploration and roaded dispersed recreation activities. Provide moderate levels of visual quality, old growth, habitat for other wildlife species and livestock forage. **Fire Management Requirement:** Fire planning will protect and enhance winter range habitat. (LRMP, Ch. II pp. III-9, III-13)
MA3a (11,847 acres 24%)	**Management Goal:** Maintain the partial retention visual quality objective and manage timber. Emphasize roaded dispersed recreation activities, old growth, and big-game cover. Provide moderate levels of timber, livestock forage, big game forage and access for mineral exploration. Restrict road density where necessary to meet visual objectives but provide access as needed for mineral exploration. **Fire Management Requirement:** Fire planning will emphasize control measures that protect visual quality. (LRMP, Ch. III pp. III-15, III-20)
MA5 (8,036 acres 17%)	**Management Goal:** Emphasize motorized and non-motorized semi-primitive recreation activities and elk security. Manage big-game winter range to maintain or enhance big-game habitat. Manage the Saddle Mountain, Nez Perce, Deer Creek, Beaver Creek, Bare Cone, Burnt Fork, Roaring Lion, Canyon Creek, and Lost Horse road corridors to provide recreation access. **Fire Management Requirement:** Visually sensitive areas along the Bitterroot Mountain face will be protected. Wildfire suppression strategies of control, contain, and confine will be utilized to meet the management objectives of this area and adjacent management areas. Firefighting equipment and methods which meet the goals and standards of this management are appropriate. (LRMP Ch. III pp. III-36, III-39)
MA 8a (132 acres <1%)	**Management Goal:** Manage at the minimum level for elk security, old growth, and habitat diversity; but protect timber, soil, water, recreation, range and wildlife resources on adjacent management areas. Maintain existing uses and facilities. **Management Requirement:** Fire planning will be designed to protect adjacent timber investments and other management area values. The types of fire suppression equipment that can be used will depend on adjacent management area objectives. (LRMP Ch. III pp. III-58, III-60)
Private Land 1,824 Acres 4%)	**Fire Management Requirement:** Through offset agreements with the state of Montana the Forest Service has fire protection responsibilities on all private lands within the project area. Aggressive, prompt control action will be taken on all wildfires. All types of fire suppression equipment may be used.
State Land (70 Acres <1%)	**Fire Management Requirement:** Through offset agreements with the state of Montana the Forest Service has fire protection responsibilities on all state lands within the project area. Aggressive, prompt control action will be taken on all wildfires. All types of fire suppression equipment may be used.

Bitterroot Fire Management Planning

A Spatial Fire Management Plan is a strategic plan that contains text based and spatially represented information that guides a full range of fire management activities and is supported by a land or resource management plan. The Bitterroot Spatial Fire Management Plan utilizes both Strategic Objectives and Management Requirements to guide fire management direction. The Bitterroot NF has chosen to use the Fire Management Units from our previous FMP’s to provide the direction and spatial bounds for Strategic Objectives and the Forest Plan Management Areas as the direction and spatial bounds for the Management Requirements. For each individual wildfire ignition, the relevant strategic objective and management requirement will be applied to direct the fire strategy depending on the fire location.

There are three FMUs within the Mud Creek Project Area. Strategic objectives for FMU’s 1 & 2 direct fire management to utilize aggressive initial attack to suppress wildfires because of their proximity to values at risk, and potential negative impacts. The portions of FMU 3 within the assessment area are outside of recommended wilderness which limits the strategic objective of managing fire for resource objectives.

Large portions of FMU 3 are adjacent to the WUI which would likely require aggressive suppression actions to minimize the potential impacts to private values.

FMU 1 WILDAND URBAN INTERFACE (17,043 Acres 35%)

This FMU includes areas where: (1) the threat to life and private property are extremely high (2) adverse public reaction is anticipated (3) values at risk are high and (4) improved recreation sites and administrative facilities are located. This FMU also includes Private, State, and Federal lands where the Forest Service has protection responsibilities. Timber, big game winter range, and visuals are also important resources that are emphasized.

Objectives: Wildfires within FMU 1 will be suppressed using aggressive initial attack actions because of the high values at risk and the high threat to life and property. During multiple fire incidents, this FMU will usually be the priority for initial attack resources.

FMU 2 ACTIVE ROADED AREAS (24,552 Acres 51%)

This FMU includes: (1) timber management lands (2) improved recreation sites and facilities and (3) lands adjacent to the Wildland Urban Interface. Timber management, big game winter range, and recreation are emphasized with in this FMU.

Objectives: For the majority of fires in FMU2, use a suppression initial attack action commensurate with the values at risk. During multiple fire incidents, initial attack resources will be prioritized based on proximity to values at risk.

FMU 3 ROADLESS and UNROADED AREAS (Outside Wilderness) (6,889 Acres 14%)

This FMU includes: (1) all the non-wilderness roadless areas (2) recommended wilderness and wilderness study areas (3) high elevation areas with a mix of previous fire scars and timber stands which can support high intensity stand replacement fires during times of drought. These areas, for the most part, have no planned timber harvest. This FMU consists of areas that either allows for multiple objectives or a single suppression objective.

Objectives: Use an initial attack suppression action that is commensurate with the values at risk. During multiple fire incidents, initial attack resources will be prioritized based on proximity to values at risk.

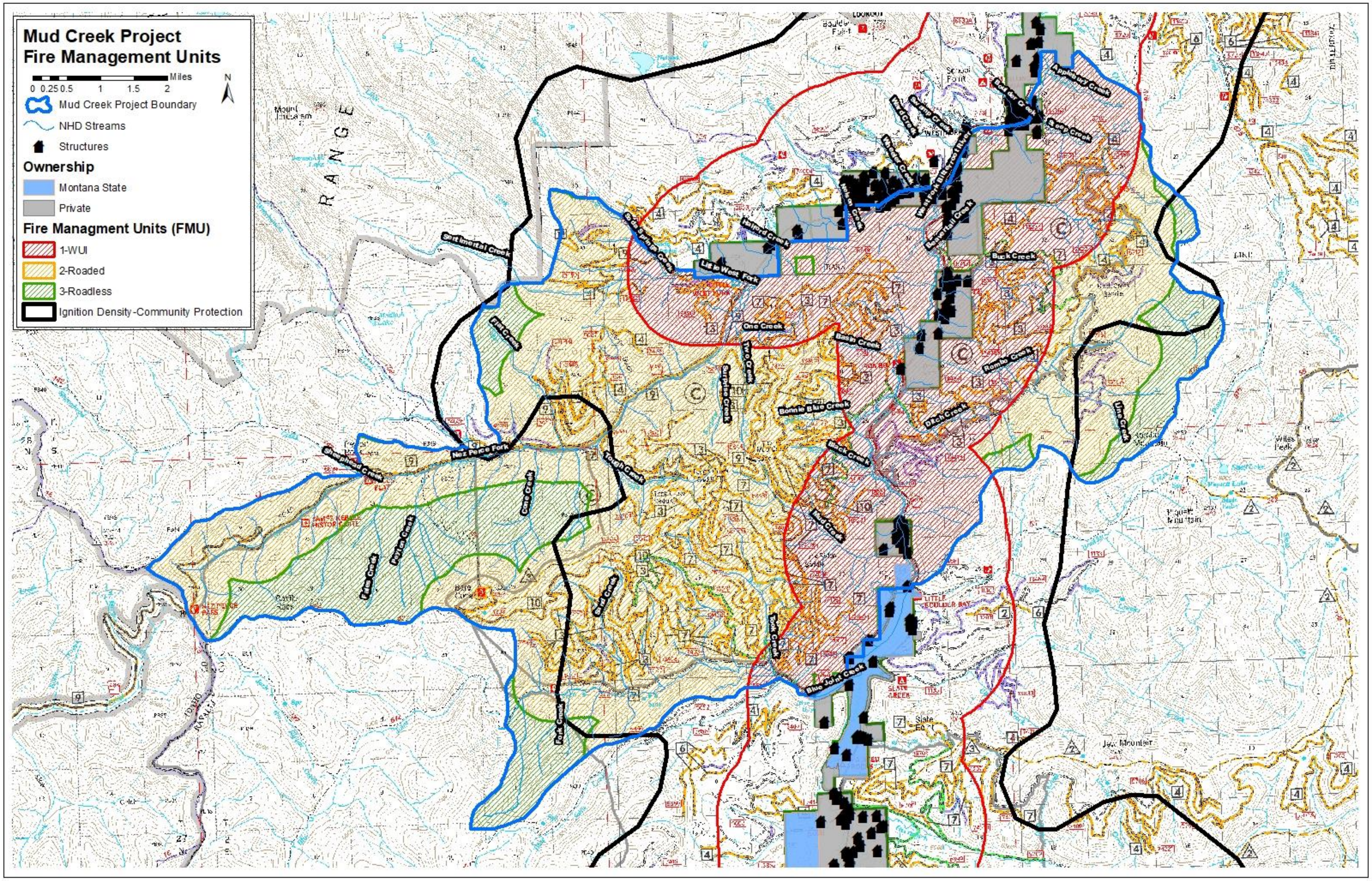

Figure 1. (Fire Management Units)

Existing Conditions

Understanding the past and present role of fire in the Bitterroot Valley is critical to understanding the area affected by the proposed action and the desired conditions for fire and fuels in this area. This section will provide information on the fire history in the project area, historical fire regimes and fire groups as well as existing fuel conditions that affect fire within the project area.

Analysis Area

The Mud Creek Project area is approximately 48,490 acres surrounding the private lands of the West Fork between Applebury Creek and Painted Rocks reservoir, south of Conner, Montana and administered by the West Fork Ranger District, Bitterroot National Forest in Ravalli County. Refer to the project area boundary for the exact extent of the analysis area.

Wildland Urban Interface (WUI)

"The urban wildland interface community exists where humans and their development meet or intermix with wildland fuel" (Federal Register, January 2001). The 2006 Bitterroot Community Wildfire Protection Plan did not designate an official WUI boundary in Ravalli County, therefore the delineation and designation of the WUI defaults to the definition and criteria for WUI specified in the Healthy Forest Restoration Act (HFRA, 2003). The WUI boundary utilized for this project was delineated utilizing the criteria identified in Section 101 (16) (B) of the Healthy Forest Restoration Act. The WUI consists of 20,841 acres or 43% of the assessment area, of which 1,824 acres is private property and 70 acres is state land. Within the project boundary there are 236 individual private property listings on the 2017 Ravalli County tax records with homes or other improvements. It is estimated there are at least 175 homes or structures on these properties.

WUI growth is increasing both nationally and locally. A report by Headwaters Economics shows that during 1990-2016, ninety four percent of new homes built in Ravalli County have been in areas with High Wildfire Hazard (Pohl, 2018). Ravalli County has the highest number of new homes and total homes located in the high hazard category in all of Montana. Wildfire Risk to Communities (https://wildfirerisk.org/) identifies Conner, MT as the most at risk community in all of Montana based on fire risk and exposure to homes and the likelihood of wildfire occurrence. The recently completed Montana Wildfire Risk Assessment report has Ravalli Country ranked as the most at risk county in the state. The report also confirms that the highest ranked at risk communities are located in the southern Bitterroot (MTDNRC, 2020). The Bitterroot National Forest continues to work with our local fire districts and the Bitterroot RC&D to promote the FIREWISE program to local landowners in order to create homes and communities that are resilient to wildfire.

The first priority in all wildland fire situations is to protect firefighter and public safety. The Federal Fire Policy direction for planning wildfire suppression strategies prioritizes the protection of life (both the public and firefighters) above private property and protecting natural resources (USDI/USDA, 1995). As fire moves across a landscape and toward, or within the WUI, the hazards assumed by the public and firefighters increase with efforts to protect private property.

The Bitterroot NF has wildfire protection responsibilities on private property throughout the West Fork WUI. These areas are identified in an agreement with the state of Montana whereby the Bitterroot NF is the primary provider of rural fire protection on private lands, many of which include housing developments and other infrastructure. This requires aggressive, prompt control action will be taken on all wildfires. As stated above the Bitterroot National Forest LMRP and fire management direction for the WUI also requires aggressive suppression actions to protect the vales at risk.

The Bitterroot National Forest has no authority to conduct fuel treatments or other wildland fire mitigations on these private lands. Some private landowners within this area of the West Fork have managed tree densities and fuels on their lands to reduce their susceptibility to negative impacts from wildland fire and insects. Exact locations, treatments and acres of fuel reduction accomplished on private land is unknown. Vegetation management on National Forest lands in the West Fork would complement the treatments on private land by extending the treatment area across a larger landscape.

In addition to the private land and homes within the WUI within the Mud Creek analysis area the Forest Service also has infrastructure values to be protected. Bare Cone Lookout, located in the western portion of the project area is one of nine staffed fire towers used during the fire season. The lookout also houses critical communication equipment used during fire suppression and forest operations. Multiple campgrounds (Fales Flat, Little West Fork, Rombo) and trailheads (Blue Joint, Nez Pass) are located within the project area.

Ignition Density-Community Protection

A comprehensive Wildfire Risk Assessment was completed for the Bitterroot NF in 2016 (Scott, 2013). During this process the Fire SIMulation System (FSIM) model used locally calibrated LANDFIRE Data to model 10,000 fire ignitions and the corresponding fire spread across the landscape under a multitude of weather and fuel conditions. One of the outputs from that simulation modeling was the creation of an Ignition Density layer that allows for areas to be classified based on the probability that fire ignitions originating in those areas will reach identified values (Communities, Infrastructure, Habitat, etc.).

The Ignition Density-Community Protection highlights areas on the Bitterroot National Forest that if a fire were to start, have a probability of reaching private land and impacting those communities or inholdings. Figure 2 (Ignition Density) displays the probability classes within the Mud Creek Project area based on the probability that ignitions in those areas will reach communities or inholdings. Currently, 72% of the assessment area has greater than a 4.3% probability that fires starting in those areas will reach private property or state lands. Classes were determined using natural breaks in the data set. The ignition density community protection zone was chosen based on the four highest density classes and the collective professional judgement and experience of the Bitterroot National Forest Fire Managers.

Table 4. (Ignition Density Classes)

Ignition Density Class	Probability-Communities/Inholdings	Acres within Project Area	Percent of Project Area
Very High	36 - 61	3,705	8%
High	23 - 36	4,714	10%
Moderate	12 - 23	8,883	18%
Low	4.3 - 12	17,686	36%
Very Low	0.25 - 4.3	13,522	28%
Rare	0 -.25	2	0%

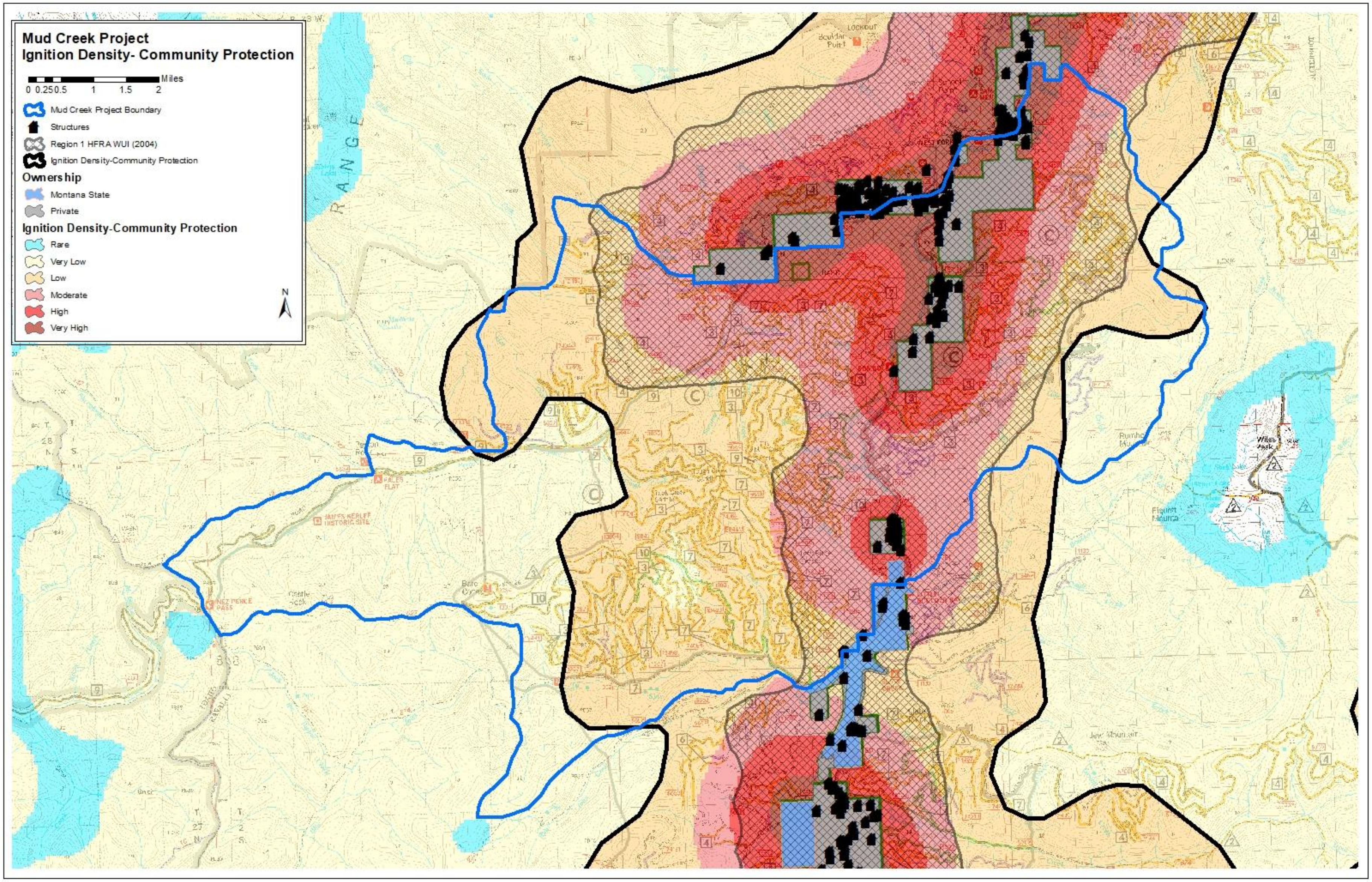

Figure 2. Ignition Density

Fire History (1889-2019)

The Bitterroot NF has averaged approximately 123 fires per year (1986-2019) and a 33-year average of over 24,983 acres burned annually by wildfire. Historically 88% of the Forest's fires occur during July through September. In general 83% of fires in a given year are lightning-caused and the remaining 17% are human-caused.

Fire history location and extent information for fires within the Mud Creek Project area was pulled from the Bitterroot National Forest fire history atlas. During the period from 1986-2019, 192 ignitions, both lightning and human-caused, were recorded within the analysis area, ranging from 1-13 (average of 6) ignitions per year. 92% of those ignitions were lightning caused and 8% were human caused. 73 (38%) of these fires occurred in the WUI and 130 (68%) fires occurred within the portion of the assessment area identified as community protection.

During the period from 1889-1940, there were twelve wildfires greater than 50 acres within the project area that burned approximately 10,050 acres or twenty percent of the project area. The majority of these acres burned prior to 1910. No large fires occurred during 1941-1988 within the project area. Since 1988, there have been nine wildfires larger than 5 acres in size, with 2 of those large fires occurring in 2000 and 1 in 2007. These fires have burned a total of 5,413 acres (11%) with the majority of the acres occurring in 2000 (3,072 acres) and 2007 (1,891 acres).

The majority of the project area has been unaffected by naturally occurring fire for over 100 years primarily due to aggressive and effective fire suppression that began around the turn of the century. Historically, large fire spread on the Bitterroot NF follows a SW to NE pattern as fire is pushed by a predominate W/SW wind. Figure 3 below shows both the fire occurrence and extent within the project area.

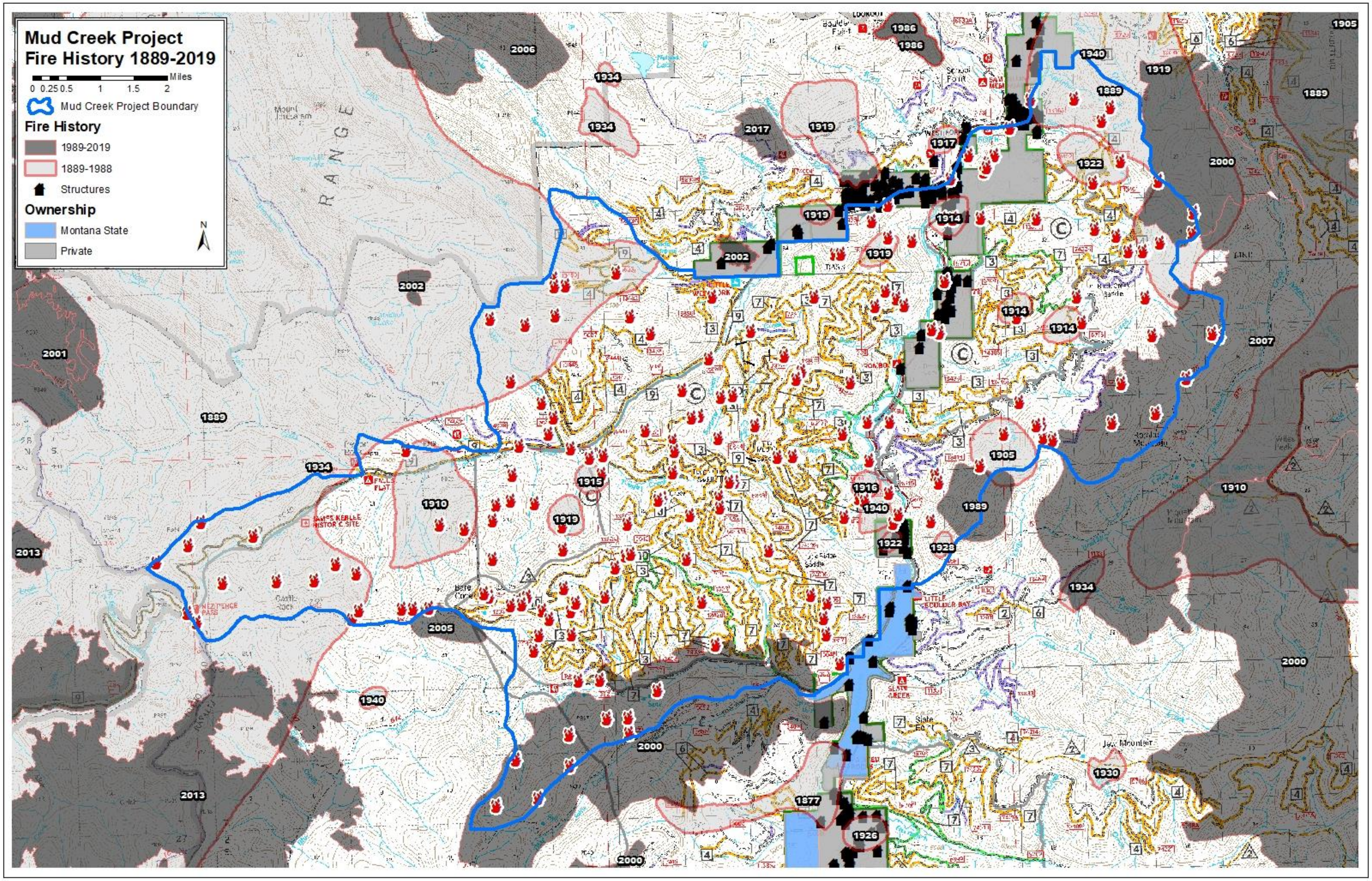

Figure 3. (Fire History)

Fire Regimes

Historically, wildland fire played a key role in shaping vegetation in the Mud Creek project area. A “fire regime” describes how fire naturally functioned in terms of extent, severity, and frequency in a particular place. Fires in wildland vegetation display a range of fire behavior and fire characteristics that depend on factors such as the vegetation composition and fuel structure, stage of succession after previous fires or other disturbances, types of past management, climate and weather patterns, terrain, and landscape patterns. The concept of a fire regime provides an integrated way of classifying the impacts of these diverse spatial and temporal patterns of fire and impacts of fire at an ecosystem or landscape level (Sommers, 2011).

Historical fire regimes in the Mud Creek project area had short to moderately short fire-free intervals, and were not typically stand replacing fires. Non-stand replacing fire regimes (Regimes I and III) represent about 79% of the project area and fire regimes with short fire return intervals (Regimes I, II) represent 74% of the area (Figure 4). Currently, 61% of area classified as Fire Regime I is at high risk of stand replacing fire. Approximately 15% of the assessment area is classified as moderately short fire free intervals (Regime IV) but generally burned with stand replacing fires. These areas are primarily dominated by cool moist forests types and located in the upper elevations of the project area.

Natural and human-caused fires perpetuated fire-adapted plant communities, maintained ecosystem health and function, created vegetation mosaics, and reduced the potential of high severity, stand replacing fires. Frequent, low severity fires were common at lower elevations while mixed to high severity fires burned less frequently at higher elevations in the Mud Creek project area. Frequent fires increased vegetative structure variability. The lack of fire within the project area has had major changes to the natural fire regimes. Fire regimes have been moderately to highly altered from their natural (historical) range. Fire frequencies have departed from natural frequencies by one or more return intervals (decreased). Risk of losing key ecosystem components is moderate to high.

The abundant literature on fire history and fire ecology of western Montana, and specifically the Bitterroot NF, supports the conclusion that stand-replacing fires were not typical to most of this area (Barrett et al. 1997, Arno et al. 1995, Agee 1993, Fischer and Bradley 1987, Arno and Gruell 1986, Arno and Petersen 1983; Habeck 1976, Habeck and Mutch 1973 and Fryer 2016). John Leiberg, who surveyed the Selway sub-basin in 1897-98, indicated that approximately 35 percent of the surveyed area had burned within the previous 40 years (Leiberg 1899). Arno (1976) found evidence in the West Fork and Tolan Creek drainages of the Bitterroot NF that fires of low-to-moderate intensity occurred most often over the landscape, with occasional stand-replacing fires. He found an average fire-free interval of 11-16 years in ponderosa and Douglas-fir and 16-27 years in Douglas-fir, lodgepole pine dominated sites during the period of 1734-1889. His fire maps show a pattern of frequent average-sized fires spreading, unsuppressed to about a square mile (640 acres). On average, a fire occurred in the drainage every seven years. The maps also showed that a very large fire, in excess of 4-square miles (2,560 acres without suppression actions), occurred approximately every other decade. These large fires were low-severity with some mixed-severity areas. There is increased recognition that most low- to moderate-intensity fire regimes in US forests included some patchy high-severity fire (Stephens, 2012). However, current wildfire high-severity patch sizes and areas in many forests that once burned frequently with low- to moderate intensity fire regimes are well outside historical conditions and this may increase as climates continue to warm (Stephens, 2012).

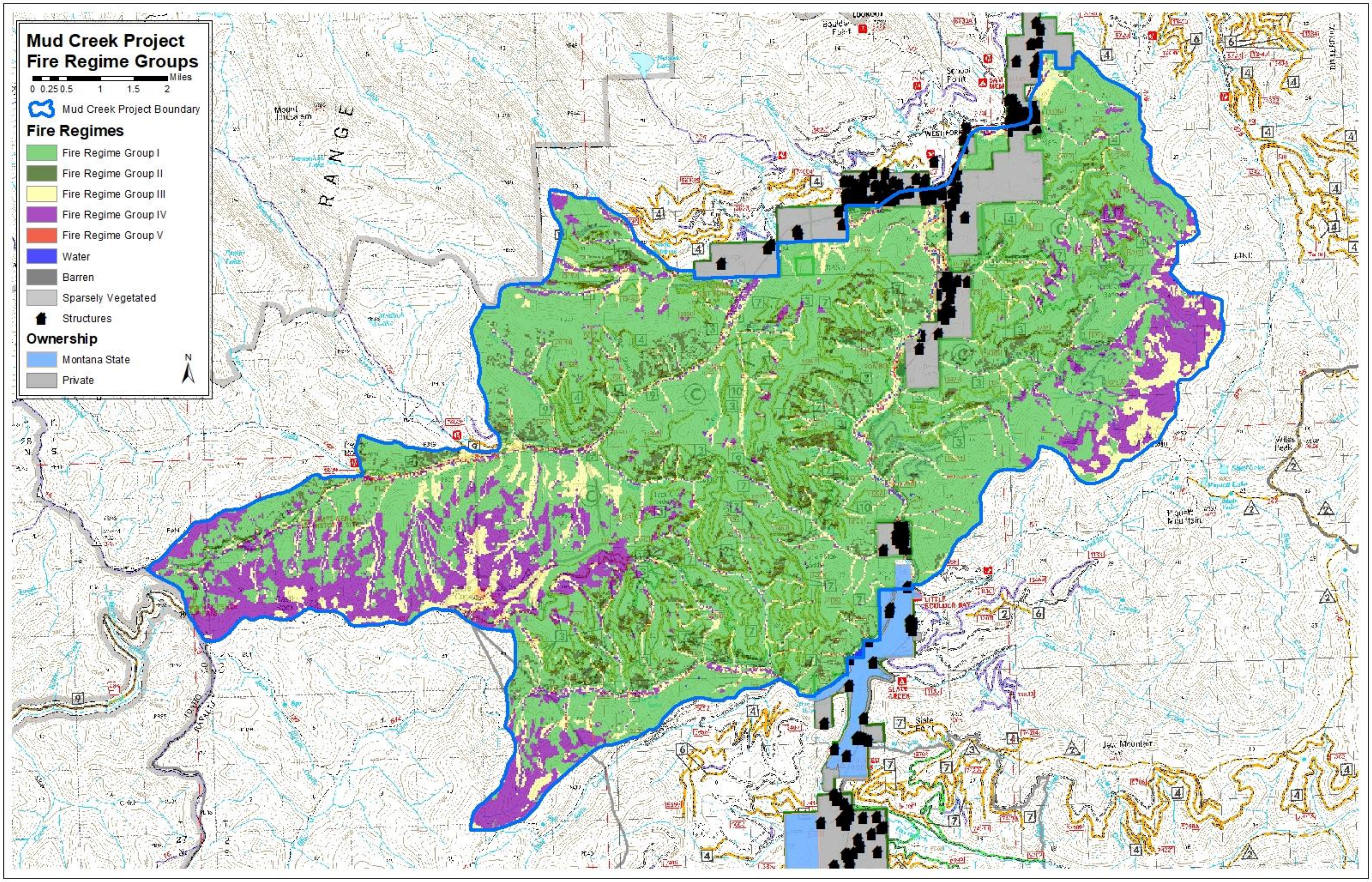

Figure 4. (Fire Regime Groups)

Table 5: (Fire Regime Descriptions for the Mud Creek Area (Adapted from Morgan et al. (2001) and Schmidt et al. (2002))

Natural Fire Regime	Frequency (Mean Fire Return Interval)	Vegetation Severity	Portion of Analysis Area[1]	Description
I	0-35 years,	Low/Mixed	68% (31,892 Ac.)	Fires in Regime Group I generally create open stand conditions with small inclusions of higher density. Understories are generally sparse. Forest gaps result when individual trees and small groups of trees are killed. Localized, heavy accumulations of fuels heat some tree boles and roots to lethal temperatures. Stand-replacing fires result when heavy accumulations of fuel are contiguous throughout the stand.
II	0-35 years,	Stand Replacing	6% (2,603 Ac.)	Fire Regime Group II, found in grass and shrub types, is similar in fire frequency to forested communities; although the intensity is much greater. Fire top-kills stands of grass and willow, but causes a "stand- replacing" effect in bitterbrush and mountain mahogany. In the grassland and willow communities, vegetation development often occurs from the re-sprouting of existing plants. Bitterbrush and mountain mahogany however, rarely resprout and fire in this community results in seral stages that are dominated by grasses and forbs
III	35-200 years,	Mixed/Low	11% (5,073 Ac.)	Fire Regime Group III has a longer fire return interval than Groups I and II. Because disturbance occurs less often, vegetative density increases and fuel accumulates, resulting in fires of greater intensity and severity than Groups I and II. Larger areas of mortality generally result, creating more diversity in age and size classes on the landscape.
IV	35-200 years,	Stand Replacing	15% (6,779 Ac.)	Fire Regime Group IV has a similar fire frequency as Group III; however, fires generally result in greater mortality because stand densities in lodgepole pine communities, the dominant vegetative type in this fire regime, are higher than those found in the drier vegetative communities in Group III. Additionally, lodgepole pine, due to its thin bark, is less resistant to fire than those species found in Group III. Arno (1976) noted that large fires in the lodgepole pine communities and spruce-fir types historically resulted from a combination of high fuel loading, drought, and wind. He also noted that non-lethal fire may have occurred in lodgepole pine forests at some time between the stand replacing events, possibly at intervals as short as 40-80 years.
V	200+ years	Stand Replacing	<1% (211 Ac.)	Fire Regime Group V generally has a much longer return interval than the other groups. Generally replacement-severity but can include any severity type in this frequency range.

Vegetation Departure & Condition Class

Vegetation Departure (VDEP) indicates how different current vegetation on a landscape is from estimated historical conditions. VDEP is based on changes to species composition, structural stage, and canopy closure. VDEP is a scale ranging from 0-100 (LANDFIRE). Vegetation Condition Class (VCC) represents a simple categorization of the associated Vegetation Departure (VDEP) layer and indicates the general level to which current vegetation is different from the simulated historical vegetation reference conditions. Vegetation Condition Classes are defined in two ways, the original 3 category system from Fire Regime Condition Class (FRCC), and a new 6 category system. For the original 3 category system, the VDEP value is reclassified as follows: Condition Class I: VDEP value from 0 to 33 (Low Departure), Class II: VDEP value between 34 - 66 (Moderate Departure), and Condition Class III: VDEP value from 67 to 100 (High Departure). The new 6 category system is defined to provide more resolution but can still be collapsed into the old 3 category system (LANDFIRE). Table 6 and Figure 5 below display the VCC classes found within the Mud Creek Project Area. The fire regime column describes the changes to the fire regime the vegetation departure has caused and the impacts should a fire occur in those areas. Approximately 83% of the project area has a moderate to high vegetation departure from historic conditions.

Table 6: (Vegetative Condition Class)

VCC Class	VCC Description	Acres (% Project Area)	Fire Regime
VCC 1A	Very Low, Vegetation Departure 0-16%	668 (1%)	Fire regimes are within the natural (historical) range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition, structure, and pattern) are intact and functioning within the natural (historical) range. Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression).
VCC 1B	Low to Moderate, Vegetation Departure 17-33%	7,361 (16%)	
VCC 2A	Moderate to Low, Vegetation Departure 34-50%	20,504 (44%)	Fire regimes have been moderately altered from their natural (historical) range. Risk of losing key ecosystem components is moderate. Fire frequencies have departed from natural frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation and fuel attributes have been moderately altered from their natural (historical) range.
VCC 2B	Moderate to High, Vegetation Departure 51-66%	17,999 (39%)	
VCC 3 A	High, Vegetation Departure 67-83%	25 (<1%)	Fire regimes have been substantially altered from their natural (historical) range. The risk of losing key ecosystem components is high. Fire frequencies have departed from natural frequencies by multiple return intervals. Dramatic changes occur to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been substantially altered from their natural (historical) range.
Water	Water	75 (<1%)	A waterbody that does not contain vegetation available to burn during a wildfire.

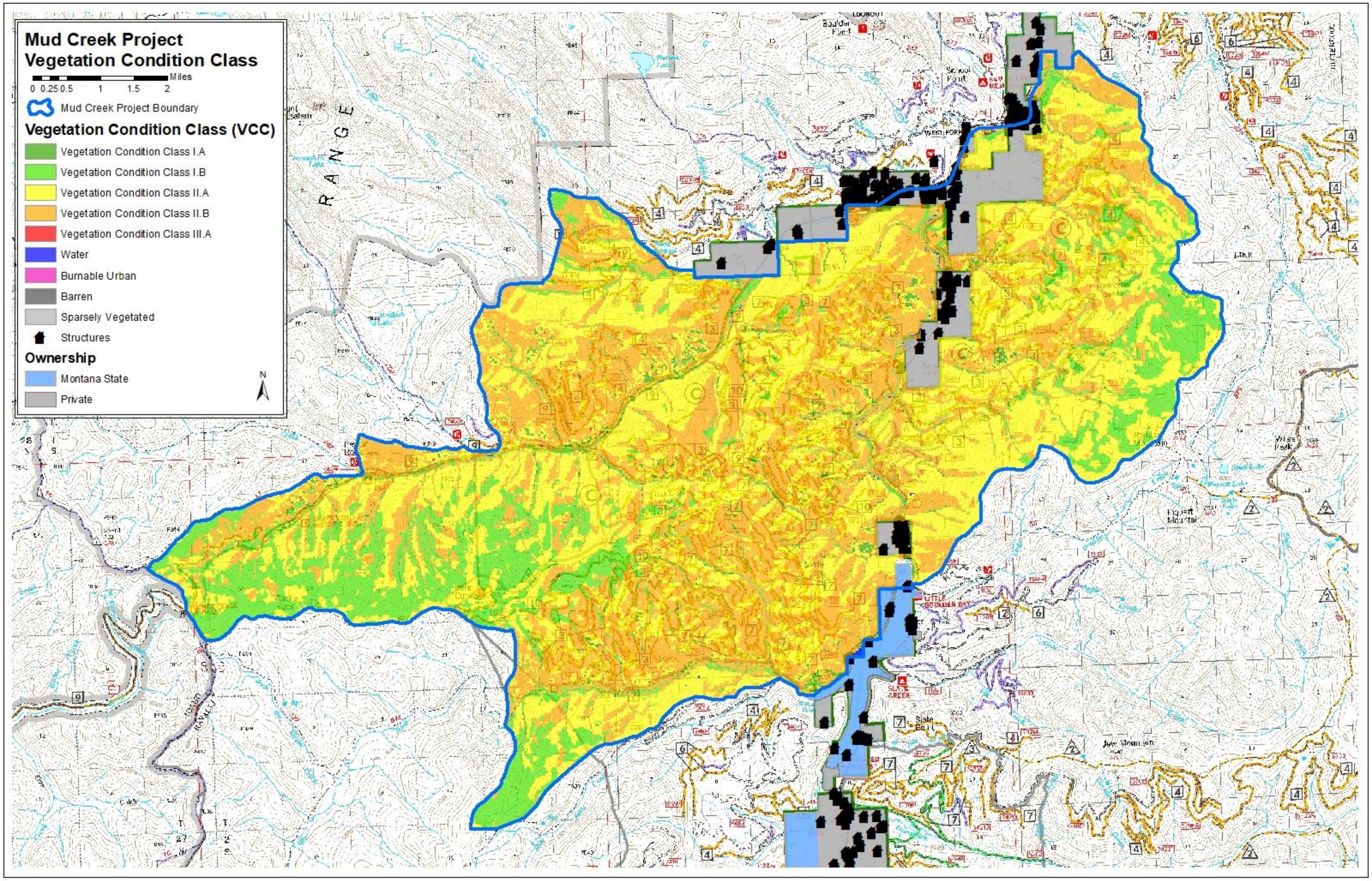

Figure 5. (Vegetation Condition Class)

Forest Types

The Mud Creek project area is made up of a variety of vegetation cover types. Cover types are identified through the USFS Northern Region Existing Vegetation Mapping Program (VMap) and are categorized by the species with the greatest dominance. Dominance refers to the species with the greatest abundance of canopy cover, basal area, or trees per acre within an area. The mapped existing vegetation is further grouped using USFS Region 1 Cover Types. Two main forest types dominate the Mud Creek project area.

Warm Dry

The warm and dry environments include the Dry Douglas-fir (Douglas-fir and Shade Intolerant Mix) and ponderosa pine cover types making up the largest portion of the project area (totaling approximately 68%). The Warm and Dry vegetation types are often found at lower elevations and on warm and dry southern and western aspects. These forests types are currently dominated by ponderosa pine and Douglas-fir. These forest types overlap with the portions of the project area classified as Fire Regime I and II. Without fire as a natural disturbance, the species composition is shifting from historically dominated fire dependent and fire tolerant ponderosa pine to a higher percentage of Douglas-fir, a less fire tolerant species. Without frequent low intensity wildfire (0-35 years), young Douglas-fir have regenerated in the understory and are competing with ponderosa pine and often prevent the successful regeneration of ponderosa pine seedlings. Stand structure has changed from historically fire maintained open grown stands containing one to two age classes to commonly found Douglas-fir ingrowth creating a ladder fuel effect leading to higher fire intensities that are often fatal for all species including ponderosa pine. As more trees grow within the same space, the stand density increases creating competition stress for resources such as sunlight, water, and nutrients from the soil. Dense stand conditions put the trees at risk for insect and disease related mortality as stressed trees lose their natural ability to be resistant to these disturbances.

Cool-Moist

The cool and moist settings include the Lodgepole pine, Spruce/fir (Engelmann spruce and Subalpine fir), and Mixed Mesic Conifer (Shade Tolerant Mix) cover types making up approximately 26% of the project area. Cool and moist vegetation types are typically found at higher elevations and/or on northern and eastern aspects. The forest vegetation in these areas are often made up of a mix of some or all the above species. Historic fire return intervals in these stands were less frequent (35-100 years) and vary in fire intensity from low to high intensity. These tree species are less fire tolerant than the warm and dry species with some species displaying little to no fire tolerance and therefore naturally experience high levels of mortality or stand replacing fire. Over time, species composition in these stands often shift from Douglas-fir and lodgepole pine dominance to a higher component of subalpine fir. Stand densities increase as more shade tolerant trees continue to regenerate on site leading to dense multistoried stands. While these wetter sites are naturally capable of supporting more trees, stand densities have continued to increase leading to conditions favorable for insects and disease that thrive in multistoried conditions. Although these areas haven’t been as impacted by fire exclusion, the lack of fire on the landscape has reduced the varied patch size and patterns that naturally would have occurred. Fewer fires have led to less diversity in stand ages and successional stages across the landscape. Without the varied patch size and patterns historically created by fire across the landscape, wildfires are burning with greater intensity over larger areas and insects and diseases can spread further with the increase in older and denser stands.

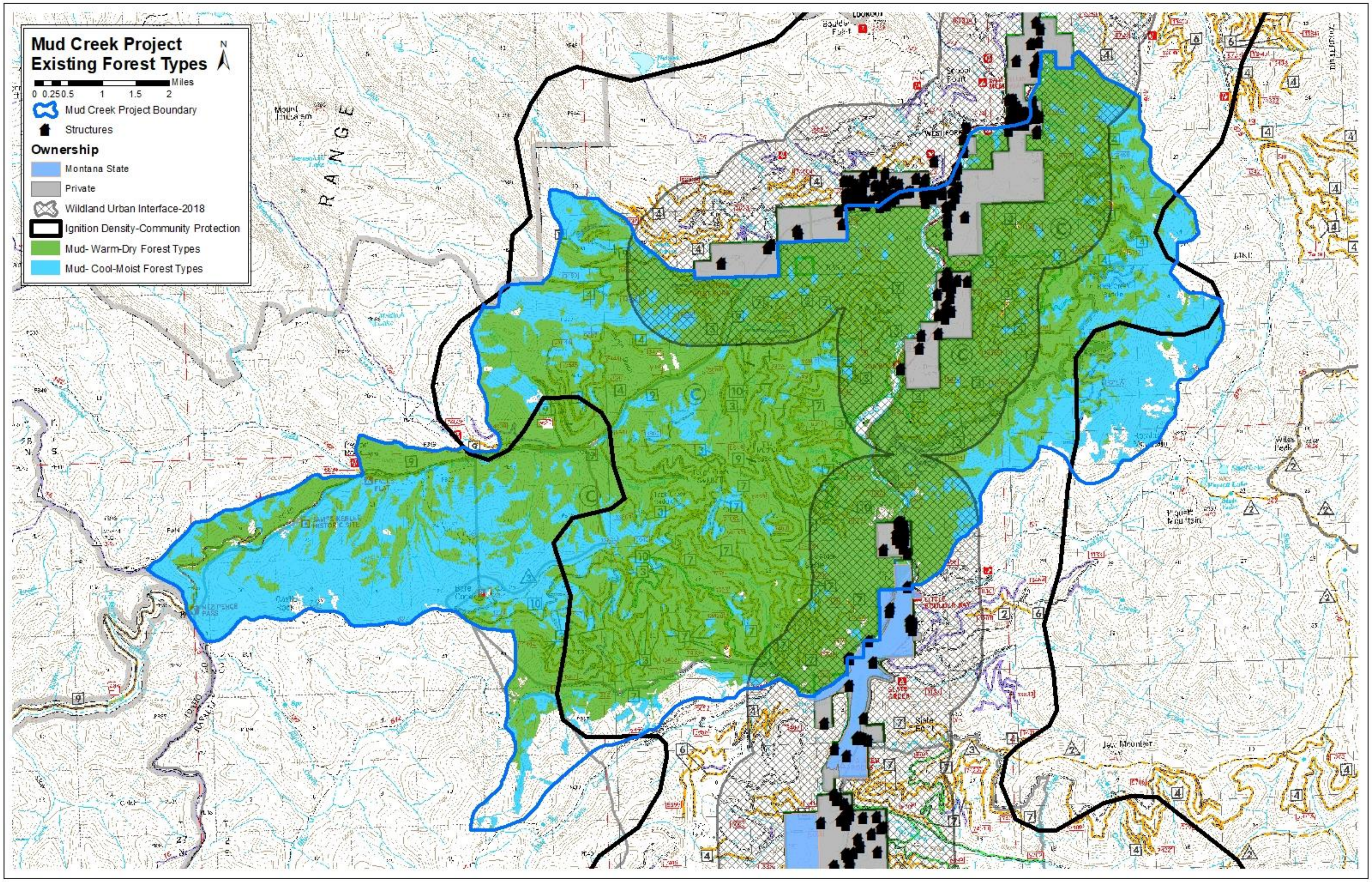

Figure 6. (Existing Forest Type)

Fire Groups

Western Montana Fire Groups (Fischer and Bradley 1987) were also used to assess landscape level departure of vegetation, fuels and the natural role of fire. The fire groups summarize available information on fire as an ecological factor for forest habitat types in western Montana. The forest habitat types are assigned to Fire Groups based primarily on fire's role in forest succession. For each Fire Group, information is presented on: (1) the relationships of major tree species to fire, (2) fire effects on undergrowth, (3) forest fuels, (4) the natural role of fire, (5) fire and forest succession, and (6) fire management considerations (Fischer and Bradley 1987). The predominant project area Fire Groups are described in Table 7 and displayed in Figure 7 below.

Fire groups are typically classified based on stand level habitat type but complete coverage of that dataset is currently not available. During stand diagnosis, stand level habitat type information will be collected or verified and used to update the fire group layer. Fire groups derived from stand level habitat type will be used during implementation. Current fire groups were derived using the Landfire Biophysical Setting (BPS) data.

Nine Fire Groups are represented within the Mud Creek project area. Fire Group 0 (12%) is found mostly in open grasslands and rock scree as well as within riparian areas that contain aspen or cottonwood. Fire Groups 2, 4, 5 & 6 (68%) dominate the area, primarily on east, south and west aspects as well as north aspects at lower elevations. Fire Groups 7, 8 & 9 (14%) are generally located on north aspects in the lower elevations and more widespread at the higher elevations. Fire Group 10 (3%) is found along ridgelines in the highest elevations. Lastly, Fire Group 11 (1%) is located in lower elevation, north slope, riparian areas that are generally warm and moist. Fire group and fire regime characteristics will be used to determine how the existing vegetation and fuel conditions compare to historic ranges within the project area as well as identifying acceptable ranges for the desired conditions.

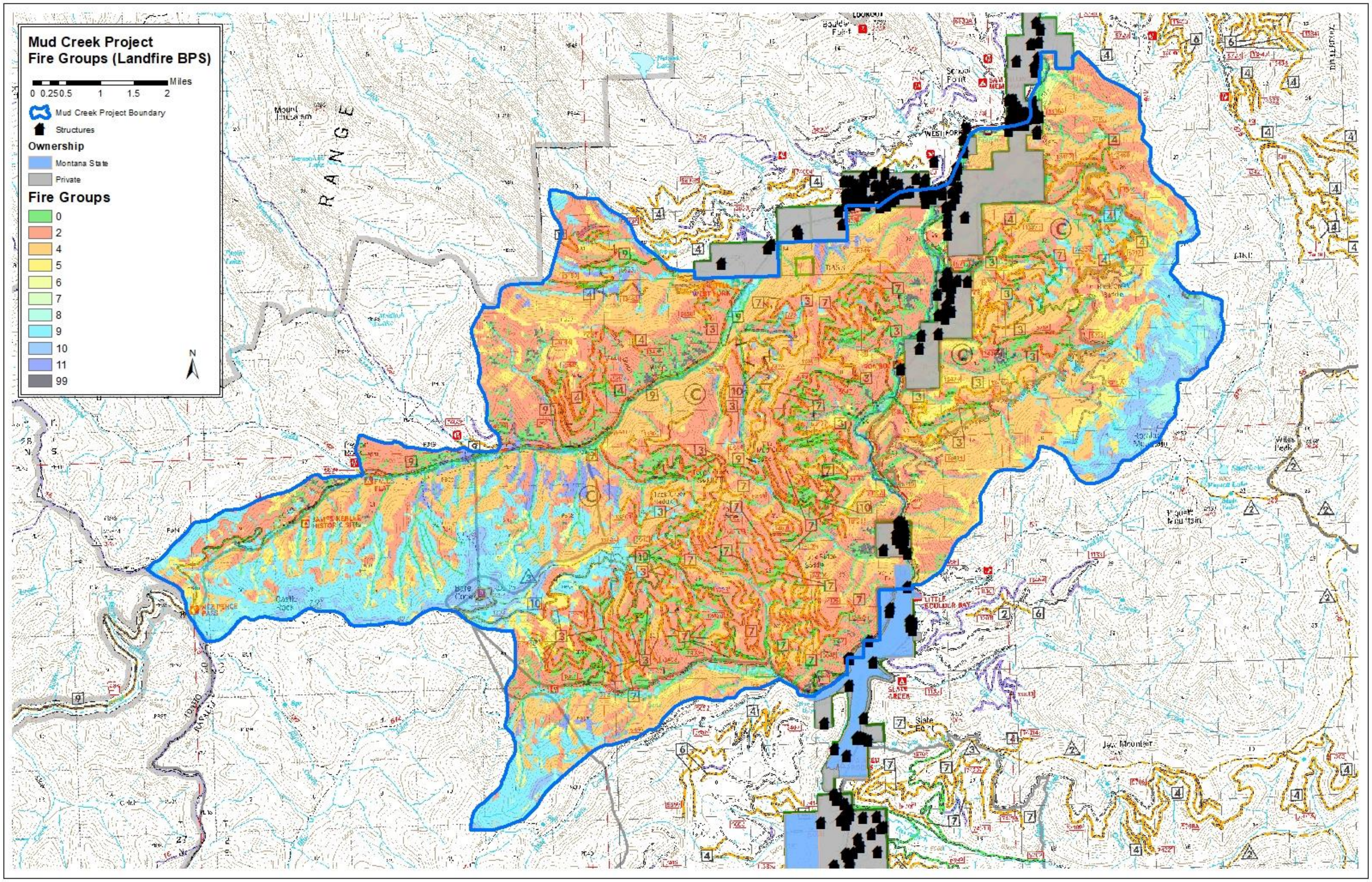

Figure 7. (Fire Groups)

Table 7: (Fire Group Descriptions)

Fire Group	Acres in Project Area (%)	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
0	5,323 (12%)	This Fire Group is a miscellaneous collection of habitats. Grasslands, aspen groves and black cottonwoods, alder glades, isolated ponderosa pine, Douglas-fir, and juniper.	This Fire Group is represented in this analysis area with rocky scree slopes, steep canyon walls. Light surface fuels with some grass component, and hardwood leaf litter.	Maintain mountain grassland and wet meadows. Encourages aspen suckering for regeneration. Enables alder stands to become denser. Re-vegetation following a fire can take a long time.	Fire Group 0 is a miscellaneous collection of habitats that do not fit into the Montana habitat type classification.	Fire absence results in individual trees or islands of vegetation to become established on scree slopes and forested steep canyons walls. Absence of fire can result in conifer encroachment upon mountain grasslands and wet meadows and the gradual elimination of aspen.	This Fire Group will not burn readily under normal summertime weather conditions and is generally not considered a fire hazard. These sites can serve as anchor points for fire breaks and fire managers can take advantage of this when developing fire management strategies. Utilizing prescribed fire in these areas is a suitable management tool for maintaining desired forage conditions in these wildlife habitats.

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
2	16,239 (33%)	This Fire Group consists of ponderosa pine stands with predominately grass undergrowth. These sites may exist as fire-maintained grassland and will support Rocky Mountain juniper and Douglas-fir as accidental individuals. In the undergrowth, common snowberry, antelope bitterbrush, and chokecherry are important shrubs. Herbaceous species include Idaho and rough fescue and white stoneseed.	Fuel loads tend to be light compared to other groups, the most abundant surface fuel is cured grass. This is especially true for mature, open-grown stands of ponderosa pine. Downed woody fuels in such stands usually consist of widely scattered, large trees (deadfall) and concentrations of needles, twigs, branch wood, bark flakes, and cones near the base of individual trees. Fuel loads in such stands may be less than 1 ton per acre.	Maintain grasslands, maintain open ponderosa pine stands, and encourage ponderosa pine regeneration.	Historically, natural fire frequencies in forests adjacent to grasslands were fairly high, according to numerous studies conducted in the ponderosa pine forest types throughout the Western States. These studies show fire to have been a frequent event, at intervals from 5 to 25 years in most locations.	Frequent fires tend to maintain the grassland communities by killing pine seedlings. Fire absence results in seedling development into saplings into pole-sized trees. In the absence of fire, the stand may become overstocked and accumulate enough fuel to support a severe stand destroying fire.	Fire management considerations for this Fire Group are wildfire hazard reduction, forage production, site preparation and stocking control, and recreation site development and maintenance.

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
4	13,859 (29%)	Ponderosa pine stands developing Douglas-fir regeneration understory. Sites are usually too hot and dry for other conifer species. Pinegrass, fescues, dogbane, wheatgrass, balsamroot, snowberry, kinnikinnick, spirea, serviceberry, and ninebark are common herbs and shrubs present.	Fuel loads tend to increase with the stand age as a result of accumulate downfall from insect and disease damage, blowdown, and natural thinning. Fuel loadings range from 1 to 20 tons per acre, averaging around 11 tons per acre.	Maintain open grasslands. Maintain open ponderosa pine stands by killing fire-susceptible Douglas-fir. Reducing Douglas-fir ladder fuels reduces the threat of fire to the mature ponderosa pine over-story. Fire prepares natural seedbeds for seral ponderosa pine.	Historically 5 – 25 years between fires. Suppression of surface fires in open, fire-maintained stands has increased conditions that create severe fire behavior.	Absence of fire will allow for Douglas-fir encroachment Stand will become overstocked and fuel loadings will increase. Natural regeneration will be slow in the absence of fire. Lack of fire to recycle nutrients and stimulate browse may reduce wildlife habitat.	The combination of Douglas-fir understories, accumulated deadfall, decadent shrubs, and litter can produce fires severe enough to scorch crowns and kill the cambium of over-story trees. Prescribed fire can reduce Douglas-fir encroachment and rejuvenate browse for big game winter and spring ranges.
5	2,648 (5%)	Douglas-fir dominates most stands and is often only conifer present. Sites are usually too dry for lodgepole pine and too cold for ponderosa pine. Juniper, whitebark pine, and lodgepole pine may occur as minor species. Undergrowth includes arnica, Solomon's seal, sweetroot, meadowrue, wheatgrass, sedge, fescue, sagebrush, and spirea.	Downed dead fuel loads average about 10 tons per acre. Downed, dead woody fuels loadings are greater than the previous Groups, but live fuels are less of a concern. Lack of undergrowth and regeneration, plus the nature of the open stands results in a low probability of crown fire.	Fire is an important agent in controlling density and species composition. Combination of overstory mortality, reducing understories, and rejuvenating sprouting plants increases browse and forage for wildlife habitats. Fire can have more a role as stand replacement agent.	Relatively light fuel loads, sparse undergrowth, and generally open stands appear to favor long fire-free intervals. Range is 35 – 45 year fire intervals.	Pre-settlement stands were maintained as seral grasslands with scattered trees inhibiting rocky microsites. The prolonged absence of fire has allowed these groves to become forest stands. Absence of fire results in mature Douglas-fir multi-storied, overstocked stands.	Fire can be used to eliminate hazardous fuels and prepare seedbeds. Light surface fires in open canopy mature stands can maintain park-like conditions and stimulate browse for wildlife habitat. A severe fire in an overstocked stand could destroy the stand and revert it back to herb/shrub stage, or thin the overstory and leave an open park-like stand.

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
6	681 (1%)	Habitat types occurring at elevations between 3,000 and 6,500 feet. Douglas-fir may dominate all stages of succession, while ponderosa pine, western larch, and lodgepole pine may also be abundant. Subalpine fir and spruce are essentially absent. Ninebark, snowberry, spirea, oceanspray, huckleberry, kinnikinnick, beargrass, arnica, sweetroot.	Fuel conditions will vary according to stand density, species composition, age, and stand history. Overstocking and the development of dense understories results in high-hazardous fuel conditions. Natural thinning, snow breakage, blowdown, and insect and disease mortality occur at high levels in these stands. Deep duff develops and may contain rotten logs. Down, dead fuel loads average 12 tons/acre and range up to 74 tons/acre.	Fire is an important agent in controlling density and species composition. Combination of overstory mortality, reducing under-stories, and rejuvenating sprouting plants increases browse and forage for wildlife habitats. Fire can have more a role as stand-replacement agent.	15 to 42 year intervals	Multi-storied Douglas-fir with a fire maintained open forest condition was the situation at pre-settlement Absence of fire will increase stand density and fuel loadings, and may decrease desired wildlife habitat.	Fire can be used to reduce risk of wildfire damage by reducing woody debris on forest floor. Potential for crown fire can be reduced by using fire to remove dense under-stories. Fire can be used to reduce hazardous thinning fuels. Fire can be used to favor ponderosa pine and western larch by preparing mineral soil seedbeds. Fire can aid in stimulating browse for wildlife.

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
7	1 (0%)	Pure lodgepole pine stands, subalpine fir, spruce, and Douglas-fir are present. Undergrowth consists of dense mats or layers of grasses and shrubs consisting of pinegrass, bluejoint, sedges, whortleberry, huckleberry, blueberry, kinnikinnick, Oregon grape, spirea, snowberry, arnica, and meadowrue.	Average down woody loading is 18 tons/acre. Inventories showed ranges from 3 to 35 tons/acre, and extreme loads in excess of 150 tons/acre. Fuel loads are characterized by relatively large amounts of material 3 inches or more in diameter. This is a result of deadfall, snow breakage, dwarf mistletoe mortality, and mountain pine beetle mortality.	Below 7,500 feet, the role of fire in lodgepole forests is almost exclusively stand replacement. Above 7,500 feet, fire spread is limited and creates a mosaic forest and disrupts the continuity of fuels.	Natural periodicity of severe fires in seral lodgepole pine stands ranges from less than 100 year to 500 years. 300 to 400 year intervals for stand destroying fire in subalpine forests.	Absence of fire creates heavy fuel loading and leads to a stand destabilizing and the breakup of a previously unburned mature stand.	Prescribed fire has been suggested as a management tool for controlling stands with dwarf mistletoe. Fire for resource benefits may be an option depending on locality and weather conditions. Timber harvests and slash disposal can be methods used to prevent stand-destroying fires. In areas of mountain pine beetle attacks, D. Cole's (1978) premise is that both wildfire and prescribed fire management plans can be developed to use fire to "create a mosaic stands within an extensive area of timber that have developed."

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
8	638 (1%)	Consists of dry lower subalpine habitat types where spruce, subalpine fir, or mountain hemlock are the indicated climax species. Douglas-fir and lodgepole pine are dominant species. Common grasses are pinegrass and elk sedge. Twinflower, snowberry whortleberry, and huckleberry are present. Arnica, meadowrue, pyrola, and false Solomon's seal are prevalent forbs.	Down dead woody fuel loadings average about 18 tons per acre and maximum loadings can measure 80 tons per acre. Stands are characterized by relatively large amounts of down woody fuels of all size classes, but especially large amounts of material greater than 3 inches in diameter. Some stands develop dense under-stories providing ladder fuels to the over-story tree crowns. Relatively deep duff layers can develop in these stands.	Occurrence of periodic low to moderate severity fire favors Douglas-fir and lodgepole pine. Such fires set back invasion by the more tolerant subalpine fir and spruce. Severe, stand-destroying fire will generally favor lodgepole pine on many of these sites.	50 to 90 years	Generalized forest succession in the dry lower subalpine habitat types of Fire Group Eight is similar to the moist lower subalpine habitat types of Group Nine. The major difference between the two is that the drier Group Eight stands experience more frequent, generally less severe fires than Group Nine stands.	Opportunities may exist to use prescribed fire to a mosaic landscape which in turn provides a diversity of wildlife habitats, diverse scenery, and enhanced recreational opportunities. These mosaics create a mixed age class landscape which can aid in reducing the probability of widespread wildfire damage to watershed values during extreme burning conditions.

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
9	6,108 (13%)	A collection of moist and wet lower subalpine habitat types in the spruce and subalpine fir climax series. Soils are moist and wet much of the year. Elevations range from about 2,900 to 7,500 feet. Englemann spruce, lodgepole pine, and Douglas-fir are major components of seral stands. Paper birch and black cottonwood may be abundant in seral stands.	Abundant undergrowth occurs on these moist sites with numerous grasses, forbs, and shrubs. Fuel loadings are similar to Fire Group Eight averaging 25 tons per acre, but can be much higher. A large percentage of the down woody fuel is material greater than 3 inches in diameter. Deep duff and large amounts of dead rotten fuel can result in severe surface fire during unusually dry conditions. Under normal moisture conditions, a lush undergrowth of shrubs and herbs usually serves as an effective fire barrier to rapid fire spread	Fire history information for moist, lower subalpine habitat types is limited. Stand condition and species composition indicate fire impact west of the Divide. The absence of spruce, subalpine fir, or mountain hemlock climax condition is evidence of past fire disturbance. Dominance of larch, lodgepole pine and Douglas-fir suggest fire created mineral soil seedbeds.	Mean fire-free intervals are probably longer than those of the drier upland sites in Fire Group Eight. Range is 100 to 150 years.	Similar to Fire Group Eight. The two groups share the same seral and climax tree species, and have the same fire response. Both groups are distinguished by the frequency and severity of fire. Due to high live and dead fuel loadings, Fire Group Nine could have an increased chance of stand replacement fire during periodic summer drought.	The often complex structure of subalpine forests reflects their fire history. These forests are a result of past patchy or uneven burns and the soil and climate characteristics. These forests often occur in roadless and designated wilderness areas where management objectives focus on watershed and wildlife values. Consequently the appropriate fire management tool may be resource benefit fires.

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
10	1,310 (3%)	High elevation forests near and at the timberline. All stands lie above the climatic limits of Douglas-fir, and many stands are above the cold limits of lodgepole pine. Subalpine fir or mountain hemlocks are climax species. Whitebark pine and Engelmann spruce are long-lived seral species. In timberline habitats undergrowth occurs in mosaics.	Characterized by relatively sparse fine fuels and moderate to heavy fuel loadings of widely scattered large-diameter fuels. Average downed woody fuel loadings are 18 tons per acre. Deep duff can occur, resulting in much of the woody material 3 inches and greater being rotten. Wind, snow-breakage, windthrow, and insect and disease mortality contribute to large diameter downfall. Stands with downed larger size class fuel loadings do not necessarily present a serious fire hazard.	Fire is secondary to site factors such as climate and soil conditions. Climatic conditions and a fire-resistant environment make fires infrequent and limits their areal extent. The most pronounced fire effect will be stand-replacing fires which could occur during extended drought conditions when severe wind-driven crown fires develop in the lower forests	Range is 35 to 300 years. Lightning does ignite fires but is usually limited to single or at most multiple trees torching in the stand. Fire frequency does not apply well in upper subalpine and timberline sites.	It may take 100 years before conifers dominate these sites. It may take another 100 years before a mature forest exists. It is unlikely that fuel or stand condition will support a fire of any consequence. Without disturbance it can take two to three centuries for an advanced successional stage where whitebark pine is established on ridge tops and south slopes.	The status of whitebark pine communities should be of concern to fire and wildlife managers. On many upper subalpine sites whitebark pine is being replaced successionally by more shade-tolerant species. This can be attributed to pine beetle and pine blister rust. Due to the remoteness of these sites, fire may be the major practical means of regenerating this whitebark pine. A management consideration for many upper subalpine and timberline forests could be developing prescriptions to allow fire to perform its natural role.

Fire Group	Acres in Project Area	Vegetation Characteristics	Forest Fuels	Ecological Role of Fire	Natural Fire Frequencies	Forest Succession	Fire Management Considerations
11	917 (2%)	Composed of moist, warm habitat types in valley bottoms, benches, ravines, and protected exposures. This Group only occurs west of the Continental Divide in Montana and reflects the inland maritime influence. Ten species of conifers may occur: ponderosa pine, Douglas-fir, Engelmann spruce, lodgepole pine, subalpine fir, grand fir, western red-cedar, western white pine, western larch, or western hemlock.	Fuel loadings average 25 tons per acre, which exceeds that of any other Fire Group in western Montana. Large material which may account for 75% of the fuel loadings is often rotten. Despite the heavy fuel loadings these sites present low to moderate fire hazard under normal weather conditions. These sites are highly productive, and pole and mature stands are usually dense.	Heavy fuel loadings exist in most stands due to high plant productivity. This combined with droughty conditions sets the stage for severe, widespread fires. Stands can be replaced and sites revert to pioneer species. Fire severities can vary greatly from minor ground fires to stand-replacement fires due to vast site and moisture differences between dry grand fir and wet cedar/hemlock types.	Range is 100 to 200 years. There are documented reports of 30 year intervals within the Swan Valley. This would represent the extreme for these forests.	True climax status, where grand fir or western hemlock or western redcedar or combinations are the only trees on site, is rarely achieved. Seral species are long-lived and fire occurs frequently enough that stands seldom develop beyond the near climax stage. Sites in Idaho that burned in 1910 still remain shrub/herb fields.	Use of fire will maintain spring and summer browse for wildlife and maintain shrub fields on south slopes for winter range. Broadcast burning is inappropriate in partial cutting units and will lead to higher mortality in grand fir, western white pine, and associated species in the overstory.

Fuel Models

Initial fuel model information for the project area was obtained from LANDFIRE (www.landfire.gov) database which is a national vegetation and fuels mapping project that provides nationally consistent and seamless geospatial data products for use in wildland fire analysis and modeling. This information was evaluated for accuracy and adjusted as needed during a fuels calibration workshop designed to improve LANDFIRE data for use at the local level. Changes were made based on field verification, photo plots and experience from fire managers familiar with fire behavior in western Montana. Detailed descriptions of each fuel model can be found in Standard Fire Behavior Fuel Models: A Comprehensive Set for use with Rothermel's Surface Fire Spread (Scott, 2005).

The dominant fuel models within the project area are a low load of dry grass, moderate load of grass-shrub, and high load of conifer litter. Wildland fires in these fuel models burn readily during fire season and will carry easily due to a continuous fuel bed. These fuel models were used to predict fire behavior for the existing conditions within the project area.

Table 8: (Existing Fuel Models)

Fuel Model	Acres (% Project Area)
NB 8 (98) open water	48 (<1%)
NB 9 (99) bare ground	439 (1%)
GR1 (101) short, sparse dry climate grass	46 (<1%)
GR2 (102) low load, dry climate grass	7,128 (15%)
GR4 (104) moderate load, dry climate grass	10 (<1%)
GS1 (121) low load, dry climate grass-shrub	792 (2%)
GS2 (122) moderate load, dry climate grass-shrub	15,976 (33%)
SH1 (141) low load, dry climate shrub	3,862 (8%)
SH2 (142) moderate load, dry climate shrub	131 (<1%)
SH3 (143) moderate load, humid climate shrub	2 (<1%)
SH5 (145) high load, dry climate shrub	5 (<1%)
SH7 (147) very high, dry climate shrub	20 (<1%)
TU1 (161) low load, dry climate timber-grass-shrub	4,056 (8%)
TU2 (162) moderate load, humid climate timber-shrub	467 (1%)
TU5 (165) very high load, dry climate timber-shrub	211 (<1%)
TL1 (181) low load conifer litter	110 (<1%)
TL3 (183) moderate load conifer litter	1,594 (3%)
TL5 (185) high load conifer litter	9,463 (20%)
TL6 (186) moderate load broadleaf litter	86 (<1%)
TL8 (188) long needle litter	4,047 (8%)

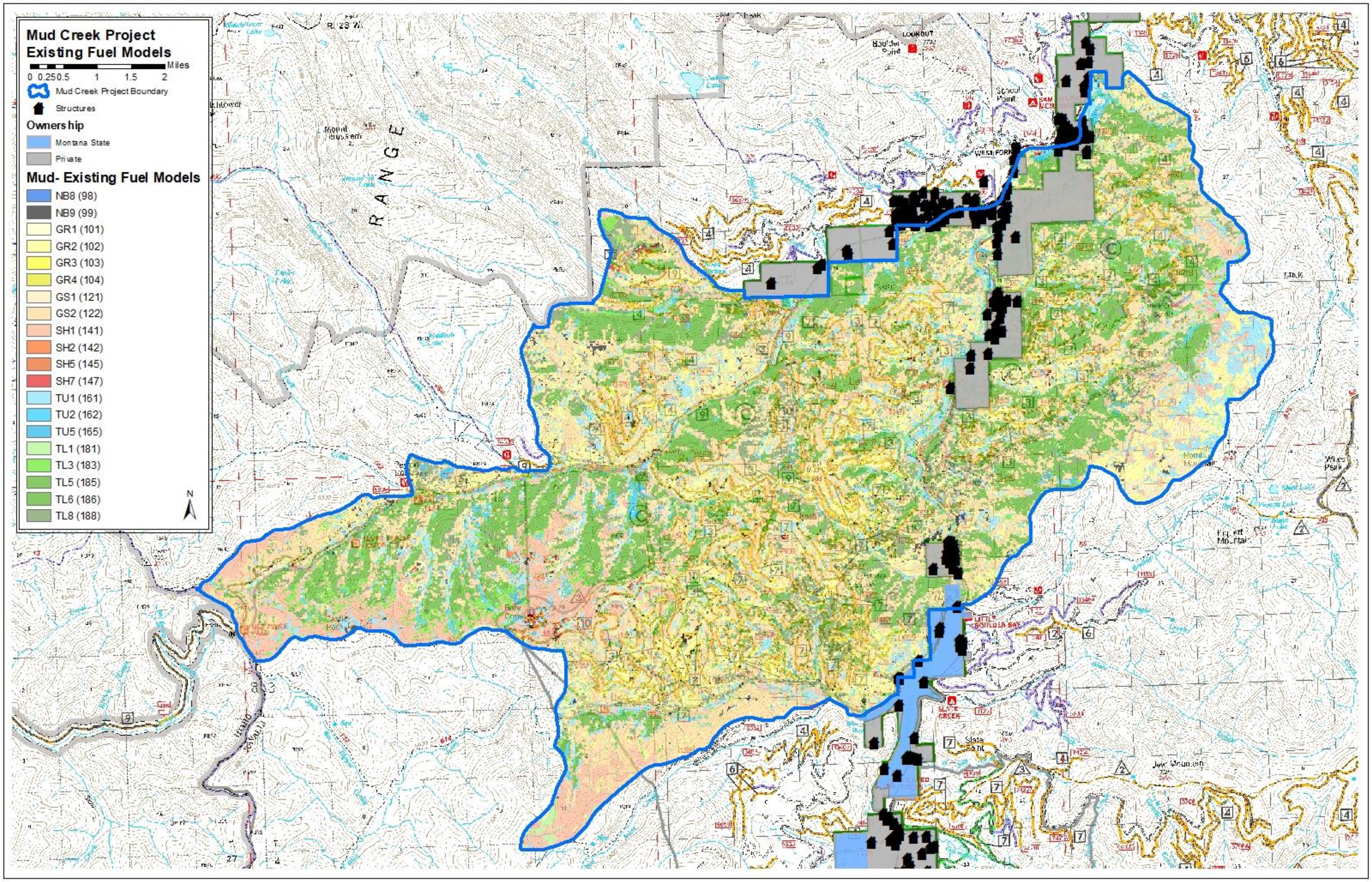

Figure 8. (Existing Conditions Fuel Models)

Fuel Loadings

Fuel loadings vary widely throughout the project area. In general many of the areas proposed for treatment exceed their historic ranges for fuel loadings based on the fire groups present in the project area. Most of the tonnage is in the form of large woody material greater than 3 inches in diameter. As mentioned in the fire history section, the majority of the area hasn't been affected by fire for over 100 years. Missed fire return intervals have allowed for natural fuels to accumulate above historical ranges. Since the early 1930s, fire suppression programs in the United States and Canada successfully reduced wildland fires in many Rocky Mountain ecosystems. This lack of fires has created forest and range landscapes with atypical accumulations of fuels that pose a hazard to many ecosystem characteristics (Kean, 2002).

Insect Impacts on Fuels and Fire Behavior

Past and current insect mortality is also contributing to some of the fuel loading. A Douglas-fir beetle (DFB) outbreak after the 2000 fires occurred during 2002-2008, killing some of the larger Douglas-fir. The majority of that mortality is now large woody fuel on the ground. Douglas-fir beetle is again active in the project area with increased mortality the past 2-3 years. Currently, approximately 30 percent of the area is at moderate to high risk of DFB mortality. If widespread DFB mortality occurs, initially it will increase the amount of red stage which has the potential to increase ease of ignition and crown fire behavior due to lower foliar moisture (Jolly et al., 2012a). Depending on the intensity and levels of mortality, there may be a reduction to canopy bulk density (CBD) after dead needles fall from the trees.

A mountain pine beetle (MPB) epidemic occurred during 2009-2015 which killed a large amount of the mature lodgepole pine and some mid-sized ponderosa pine, primarily in older, dense plantations. This mortality is now in the late stages of the grey phase and is contributing large woody fuels as these trees begin to fall over. As the remainder of the MPB mortality falls down and accumulates on the forest floor, fuel loadings, especially in the larger categories, are expected to continue to increase over the next decade. Research suggests that as the epidemic progresses, there is a gradual accumulation of medium and coarse woody fuels and increases in fuel bed depth. Page and Jenkins (2007) found a 2.5- to 7.8-fold increase in coarse woody fuels in MPB-attacked lodgepole pine forests in Utah approximately 20 years after an epidemic. Similarly, Klutsch (2009) and Collins (2012) predicted 4.5- and 5.5-fold increases in large woody fuels, respectively, after MPB epidemics in Colorado (Jenkins, 2013).

The potential for active crown fire may be reduced during the grey stage, however, few researchers have explored fire behavior in gray-stage forests and forests with fallen snags. Fire managers in Canada reported that standing gray-stage trees shed bark that could generate embers and increase spot fire occurrence, potentially as far as a half-mile away. "Research also suggests that fire hazards and behavior will change after the gray-stage as snags drop to the ground. Collins and others (2012) estimated that windthrown snags will cause a >5-fold increase in the coarse surface fuels in beetle-killed stands with no fuels reduction treatment. Wind speeds are likely to increase throughout the forest, fanning fast fires through accumulations of dry fuels (Linn et. al 2013). A higher prevalence of open canopies and coarse surface fuel loads are likely to increase surface fireline intensities. These changes could facilitate active crown fires at lower wind speeds across all moisture scenarios in gray-stage or dead-and-downed stands, even 30 years after a MPB attack (Schoennagel and others 2012).

Falling snags and jack-straw logs are serious hazards for firefighters. Suppression forces should expect increased difficulties in fireline construction, increased difficulties in establishment of access and egress, and trouble in establishing and using escape routes and safety zones. In addition, fire line production rates drop when more logs need cutting (Page 2013). This has the potential to reduce the success of initial attack and require additional suppression resources (crews or equipment). The widespread snag hazards also pose a serious safety risk to firefighters. Fires in these forests may grow exceptionally large due to an unwillingness to put firefighters at risk." (Matonis et al. 2014).

It is important to emphasize that these conditions are significant and not short-lived and that MPB-affected forests might exhibit some degree of altered fire behavior for up to a decade or more after a MPB outbreak. Creating forest structures that are more resilient to wildfire at the stand and landscape levels may decrease the concerns and costs associated with fire suppression activities and the susceptibility of forests to MPB outbreaks (Jenkins, 2013).

Fire Behavior

Fire Type

Fire type is used to describe current fire behavior conditions in the Mud Creek project area. "Fire Type" describes whether the fire is a surface fire, an intermittent crown fire (also described as a torching fire), or a crown fire. A surface fire burns in the understory with relatively low flame lengths and intensities and consumes litter, duff, and low-growing vegetation. A passive crown fire is a fire where flames move from the surface to consume single or small groups of overstory trees. Tree torching is determined by weather, total fuel load, live fuel moistures (for those fuel models that incorporate live fuels in addition to dead fuel) and ladder fuels (Andrews and Chase 1989). Passive crown fire behavior is of a higher intensity than surface fire, but is not sustained. An active crown fire is one that becomes well-established in the overstory, moving from tree crown to tree crown at high intensities and high rates of spread while consuming surface fuel as well as overstory tree crowns. Crown fires are sometimes referred to as stand-replacing fires. Crown fire potential is increased by high wind speeds, low foliar moisture content, high surface fire intensity, presence of ladder fuels, sufficient canopy bulk density to sustain fire spread, and an unstable atmosphere (Van Wagner 1977, Rothermel 1991). Once a crown fire is established it tends to affect large areas because it moves fast and is usually impossible to control until fuel or weather conditions change the fire behavior.

Crown fires and torching trees are dangerous because they can loft hot firebrands that are carried long distances by prevailing winds. When firebrands land on receptive fuels, they have the potential to start "spot fires" ahead of the main fire. Spot fires severely limit the ability of firefighters to contain a fire. Spotting is determined by the source of the firebrands, how far they travel, and the probability of ignition upon landing (Rothermel 1983). Short-range spotting is not crucial because the main fire often overruns the spots and they contribute little to forward fire spread. Long-range spotting occurs when embers are lofted in the convection column of the fire and carried a mile or more in front of the main fire. They start new fires that burn independently of the main fire. Long-range spotting is hard to predict except that it is associated with high fire intensities, torching, crowning, and fire whirls (Rothermel 1983). Fires exhibiting long-range spotting pose some of the greatest threats to firefighter safety because they are extremely difficult to control and are less predictable. Reducing excessive surface fuel loads, ladder fuels, and crown bulk density by increasing crown spacing decreases the potential for extreme fire behavior. Surface fires were the more typical fire type in the lower-elevation, dry forests of the analysis area, and therefore, preferred to torching and crowning fires for both ecological benefits and fire suppression. Residents of the area favor lower intensity fire because high intensity fires could threaten their safety, and reduce scenic quality by killing large tracts of forest.

The most important changes to stand structure and composition in the Mud Creek analysis area have been increases in small to medium-sized, shade tolerant conifers that are sensitive to fire and the increases in surface fuel loadings beyond their historic ranges. Higher densities of shade tolerant tree species in the understory lowers crown base heights and links surface fuels to crown fuels. These understory trees act as ladders that allow fire to burn into the overstory tree crowns. Stands in which fire has been excluded for long periods tend to be multi-storied and multi-aged with an abundance of shade tolerant species in the understory. Preheating of vegetation due to increased dead and down fuel loads allows fire to move from trees with low crown base heights into the multistoried crown causing the loss of larger overstory trees that have survived low intensity fires prior to fire suppression.

Increased stand density decreases crown spacing. The tighter the tree spacing, the easier it is for fire to move from crown to crown. Wind provides the mechanism for this behavior, so the tighter the tree crown spacing, the less wind it takes to move fire through the tree crowns under specific conditions.

Fire Intensity

Fireline intensity is widely used as a means to relate visible fire characteristics and interpret general suppression strategies. There are several ways of expressing fireline intensity. A visual indicator of fireline intensity is flame length (Rothermel 1983). These flame length classes and interpretations are familiar to fire managers and are widely accepted as an intuitive communications tool. Table 9 compares fireline intensity, flame length, and fire suppression difficulty interpretations.

Table 9: (Fireline Intensity Interpretations)

Fireline Intensity	Flame Length	Interpretations
Low	< 4 feet	Direct attack at the head and flanks with hand crews; handlines should stop spread of fire.
Moderate	4–8 feet	Fires are too intense for direct attack on the head by persons using handtools. Handline cannot be relied on to stop fire spread. Equipment such as dozers, engines, and retardant aircraft can be effective.
High	8–11 feet	Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the fire head are likely ineffective. This fire would require indirect attack methods
Very High	> 11 feet	Crowning, spotting, and major fire runs are probable; control efforts at the head are likely ineffective. This fire would require indirect attack methods.

Table based on Rothermel (1983)

Fire Behavior Modeling

The potential fire type and intensity below is based on existing fuel conditions within the project area. Inputs used for fuel moistures and weather parameters typical of severe conditions are found in Table 2. Flammap 5 was used to produce the existing conditions outputs.

Table 10: (Existing Conditions Potential Fire Type, Flame Lengths & Rate of Spread)

Fire Type	Acres (% of Project Area)	Acres within Wildland Urban Interface (% of WUI)	Acres within Community Protection Zone (% of CPZ)	Acres within Warm-Dry Forest Types (% of Warm Dry)
No Fire (non-burnable)	486 (1%)	207 (1%)	366 (1%)	305 (1%)
Surface Fire	22,331 (46%)	9,367 (45%)	15,860 (45%)	13,744 (43%)
Passive Crown Fire	25,618 (53%)	11,224 (54%)	18,939 (54%)	17,801 (56%)
Active Crown Fire	55 (<1%)	36 (<1%)	44 (<1%)	29 (<1%)
Flame Length (Feet)	**Acres (% of Project Area)**	**Acres within Wildland Urban Interface (% of WUI)**	**Acres within Community Protection Zone (% of CPZ)**	**Acres within Warm-Dry Forest Types (% of Warm Dry)**
0-4	486 (1%)	217 (1%)	366 (1%)	305 (1%)
4-8	20,082 (41%)	8,177 (39%)	13,501 (38%)	11,520 (36%)
8-11	18,031 (37%)	7,445 (36%)	13,570 (39%)	12,836 (40%)
11+	9,892 (20%)	4,999 (24%)	7,773 (22%)	7,218 (23%)
Rate of Spread (Chains/Hour)	**Acres (% of Project Area)**	**Acres within Wildland Urban Interface (% of WUI)**	**Acres within Community Protection Zone (% of CPZ)**	**Acres within Warm-Dry Forest Types (% of Warm Dry)**
0-5	17,515 (36%)	7,382 (35%)	11,902 (34%)	10,259 (32%)
5-10	6,982 (14%)	2,579 (12%)	4,794 (14%)	4,159 (13%)
10-20	9,573 (20%)	3,909 (19%)	7,022 (20%)	6,342 (20%)
20-40	9,918 (20%)	4,512 (22%)	7,729 (22%)	7,383 (23%)
40+	4,502 (9%)	2,456 (12%)	3763 (11%)	3,737 (12%)

Currently, under severe conditions the potential flame lengths coupled with the existing stand characteristics, topography and potential fire weather would result in 46% of the project area burning as surface fire, and 53% of the project area burning as passive or active crown fire. Predicted flame lengths on 98% of the project area would exceed the conditions that allow firefighters to safely and effectively suppress a wildfire using direct attack with handtools. The predicted fire type and intensities would make it necessary to utilize indirect suppression tactics, requiring larger numbers of firefighters, mechanized equipment, and aircraft to be successful at containing a wildfire. An indirect strategy also generally results in an increase in fire size and the area affected in order to find suitable fire line locations and fuel conditions. Portions of the project area that previously burned during wildfires in 2000 and 2007, are predicted to have reduced fire behavior. However, despite the reduced fire behavior, the snag hazards to firefighters would likely limit the direct attack of fires in these areas.

Crown fire activity reduces the effectiveness of fire suppression efforts and compromises the safety of firefighters and the public. This type of fire behavior within the WUI would most likely lead to immediate evacuation notices for residents in this area of the West Fork which could impact approximately 175 homes for an extended period of time. Fire in this area could also impact the West Fork highway affecting ingress/egress to the residents above Painted Rocks Lake in the upper West Fork.

Based on fire regimes and fire groups, crown fire behavior is also outside the range of variability for the warm-dry forest types that dominate the project area. Historically warm-dry forest types primarily burned frequently and mostly as low intensity surface fires. Currently 56% of the warm dry forest type is expected to burn as a crown fire. Based on the vegetation condition classes found within the project area, the risk of losing key ecosystem components are moderate to high. Conditions like these can lead to high acreage burned and significant adverse effects on resources (Scott and Reinhardt 2001). Key variables that contribute to these levels of fire activity are; fuel arrangement, fuel loading, drought, dry windy weather and steep slopes. Of these variables, fuel is the only one that can be controlled or changed. The planned and progressive implementation of fuels treatments in and near areas with values at risk (ecosystem function, habitat, and infrastructure) would reduce the potential for negative impacts from wildfires in these areas by reducing ladder fuels, fuel loads, canopy bulk densities, canopy cover, increasing canopy base heights, reducing surface fuels and diversifying stand structure.

Fires that occur after treatments would encounter breaks in continuity of fuels, which could limit the spread and intensity of some of these fires. Treatments are designed to be effective at reducing negative fire effects, fire behavior and improving success of fire suppression resources at or below 97 percentile conditions, not for rare weather events. At some point (extreme burning conditions during wind events and/or limited resources) suppression resources would have limited effect to successfully suppress a fire. In this case, the fire could simply spot over the treated area and continue burning, however, it is still expected that the area treated would have reduced fire behavior and effects compared to untreated areas (Prichard, 2020).

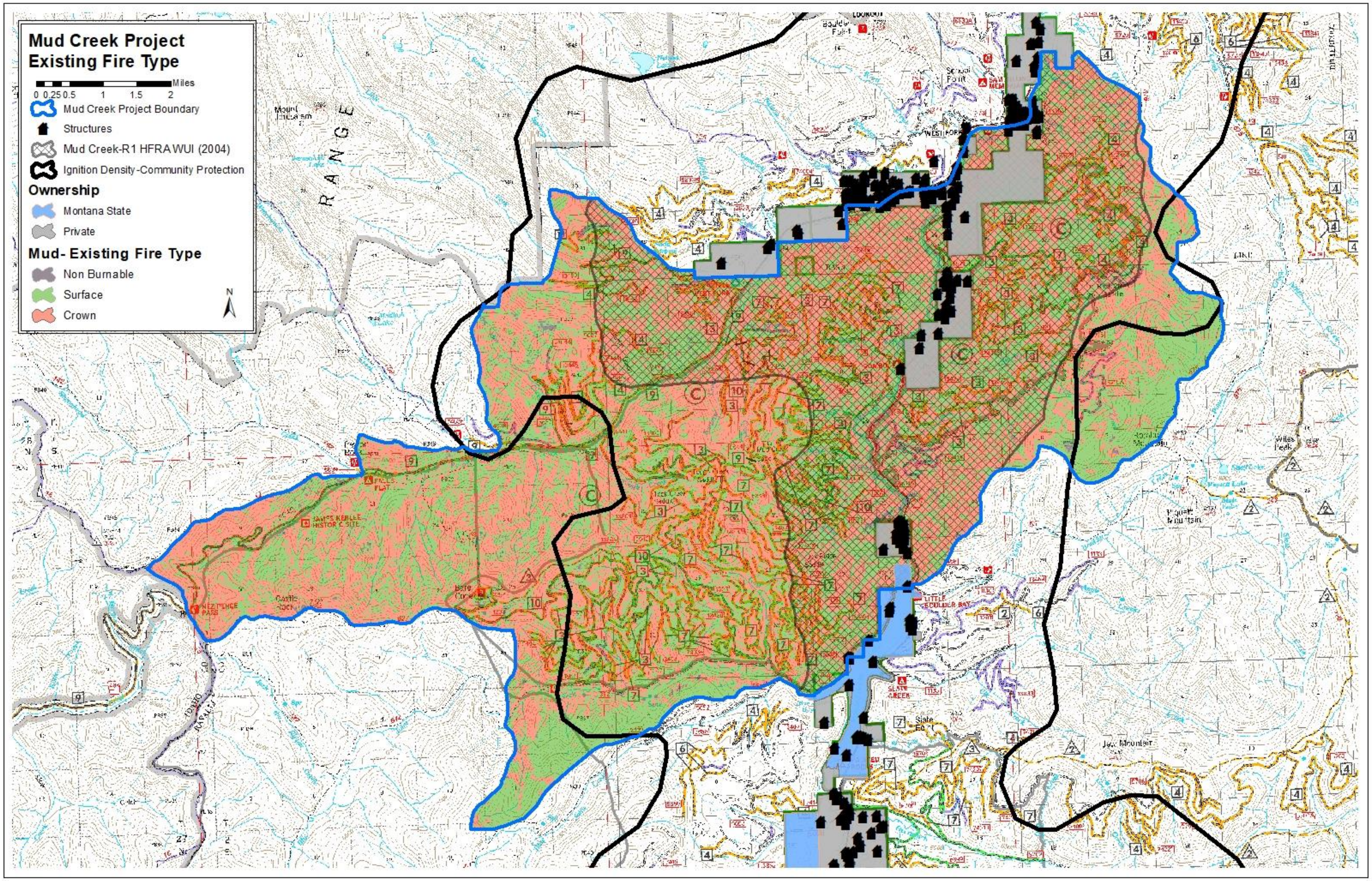

Figure 9. (Existing Fire Type)

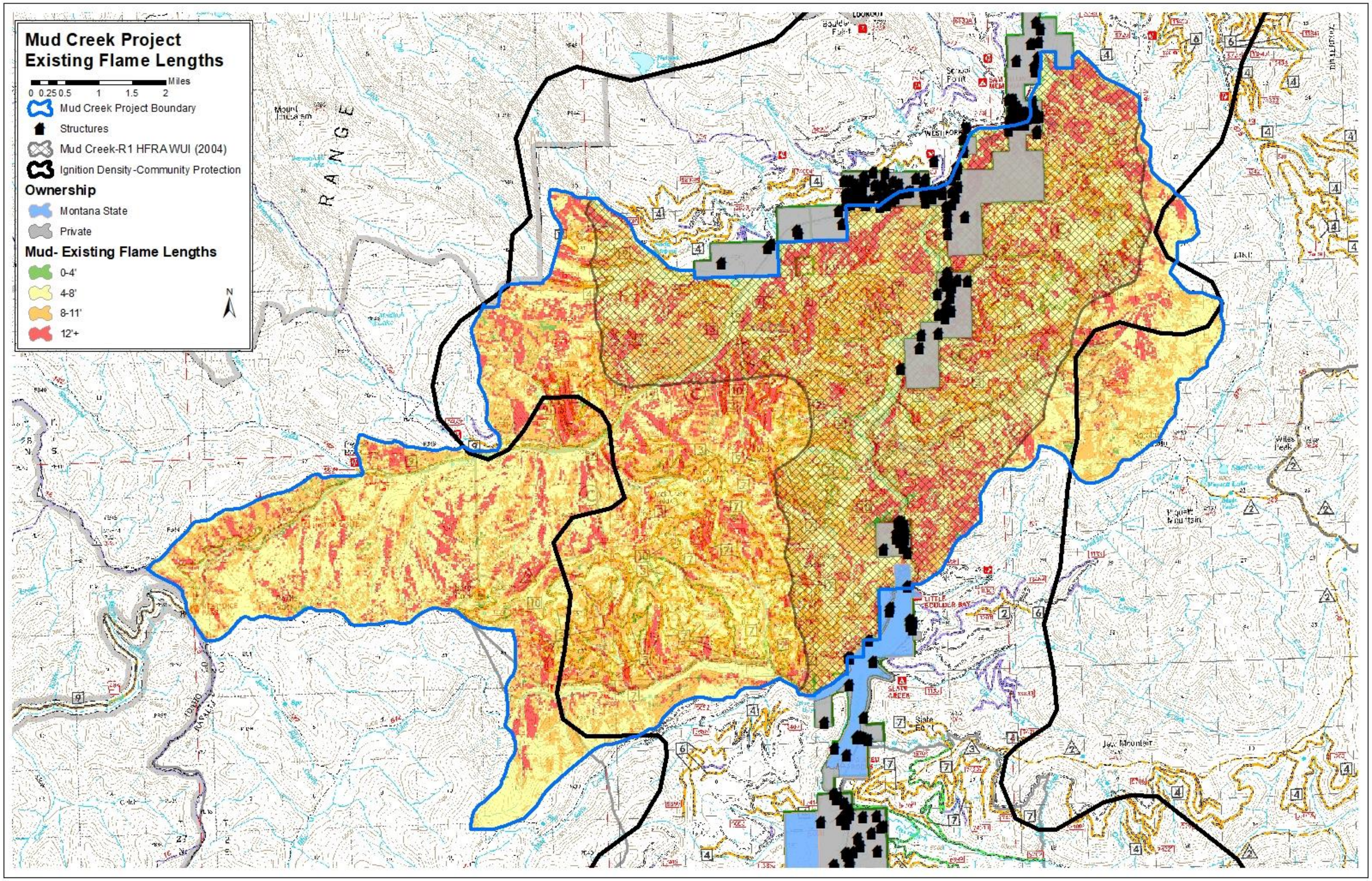

Figure 10. (Existing Flame Lengths)

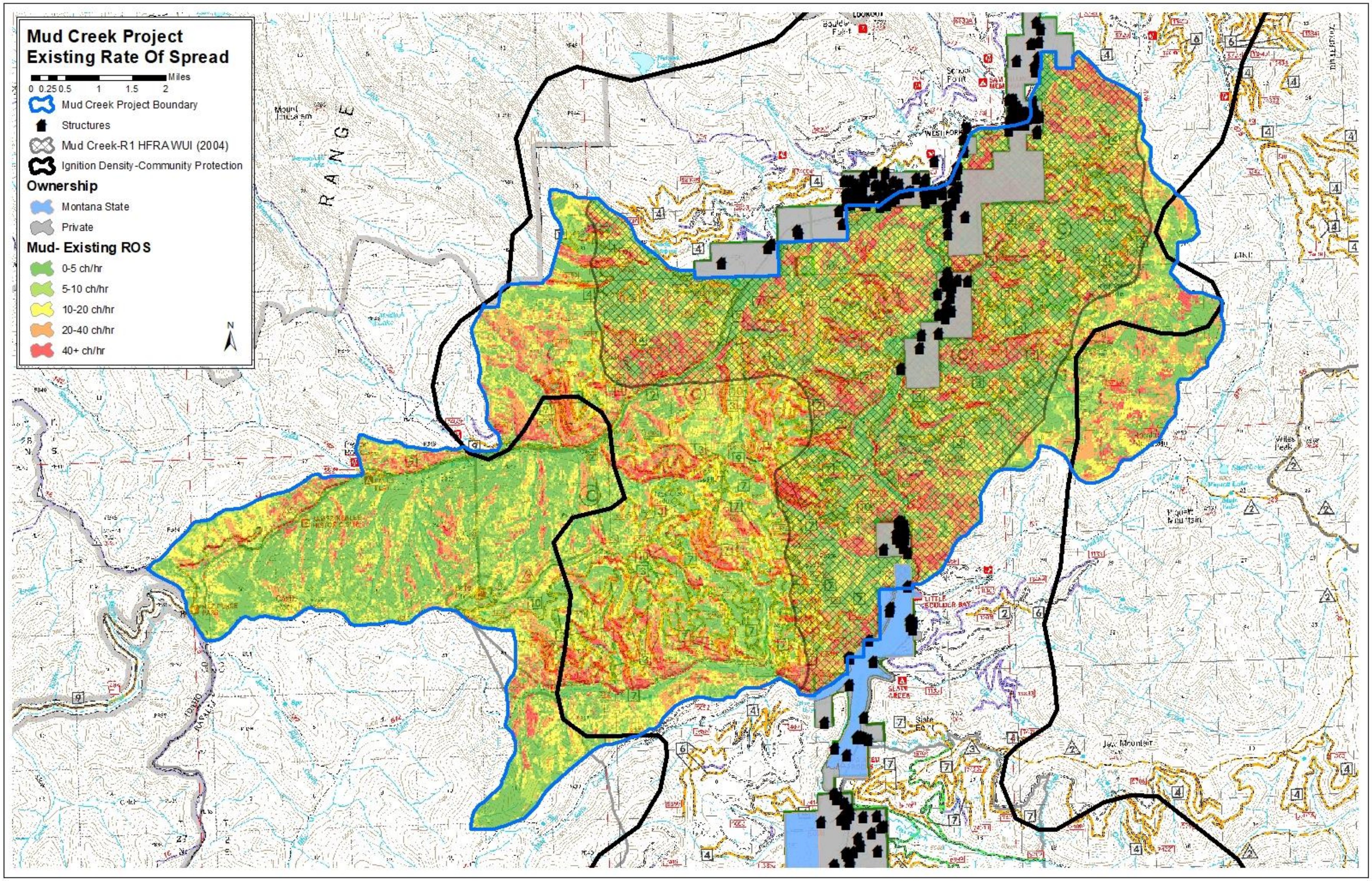

Figure 11. (Existing Rate of Spread)

Desired Conditions

Areas within the WUI, Community Protection Zone and low severity fire regimes typically found in the Warm-Dry forest types, generally exhibit surface fire behavior under severe conditions. This type of fire behavior would mimic the low severity fire expected within the forest types and fire regimes that dominate the project area. Future wildfires exhibiting low intensity, surface fire would create favorable conditions that generally allow for aggressive, direct, fire suppression tactics when warranted. Low intensity surface fire would also improve firefighter and public safety and increase the probability of success of initial attack. Negative impacts from fire on values at risk (private land, infrastructure, merchantable timber, visuals, and critical wildlife habitat) within the project area are minimized. Low intensity fire will also minimize overstory tree mortality, protecting visuals and merchantable timber. Forest conditions that allow for low fire intensities will increase wildfire control options on national forest lands prior to a wildfire impacting private land. Surface fire will allow for conditions where protection of infrastructure can be safely and successfully implemented prior to a fire impacting that value whether it is a private residence, lookout tower, bridge, trailhead or campground. Fuels and vegetation conditions that produce low intensity fire will also allow for increased use of fire (prescribed fire and wildfire) allowing fire to function as a key component of the ecosystem necessary to maintain desired fuels and vegetative conditions.

In areas outside of WUI, that are dominated by cool-moist forest types and fire regimes that historically exhibited mixed or stand replacing fire, it is desirable to have fire as part of those systems, where appropriate, to reduce fuel continuity and create landscape diversity. Mixed and stand replacing fire was historically typical in these areas (Fire Regimes III-V) which comprise about 26% of the project area. A desired outcome of implementing activities proposed by this project is to increase the ability to utilize fire (wildfire or prescribed) on the landscape to maintain natural processes and create landscape diversity while minimizing impacts to onsite or adjacent values susceptible to mixed or stand replacing fire.

Vegetation conditions have a low to moderate departure from their historic conditions minimizing the loss of key ecosystem components should a wildfire occur. This would result from leaving both stands and a landscape that resemble and function as a historic forest. The forest has variability in structure and is resilient to disturbance factors. In priority areas, activities that reduce canopy cover and canopy bulk density leaving well-spaced tree crowns or canopy gaps will reduce the likelihood of crown fire spread. Ladder fuels near the base of overstory trees are non-existent with overall increased height to live crown, reducing the potential for initiation of torching (passive crown fire). Surface fuel loadings are within the range of variability based on fire group while still allowing for effective fire suppression when needed. Prescribed fire is applied to reduce fuels, raise canopy base heights, remove excess natural regeneration, maintain fire return intervals and provide other ecological benefits.

Environmental Effects

No Action

Effects of No Action

Taking No Action would not actively change any of the fuel conditions that contribute to fire intensity or fire type; therefore, there would be no direct effects in regard to forest fuels or fire behavior. With no modification of fuel loading and forest structure, fire behavior under normal, summer conditions would persist as described under the existing condition, threatening resources within the project area. Potential fire behavior characteristics are expected to be similar to those described under the existing condition and summarized in Table 10. 53% of the project area would still exhibit passive crown fire and 98% of the area would have fire intensities that would be unsafe for direct attack by firefighters. The WUI (54%), Community Protection Zone (54%) and Warm-Dry forest types (56%) would still be susceptible to crown fire.

Aggressive fire suppression will continue within the project area as directed by the forest plan and the Montana DNRC offset agreement for protection of private lands. This will continue the exclusion of fire from the ecosystem. Expected fire behavior, continuous fuels and hazard trees that create unsafe working conditions will limit fire management options and eventually lead to a reduced probability of success in suppressing fires during initial attack. Wildfires that escape initial attack are likely to become large and damaging because of the expected fire behavior and the values at risk within the project area.

In the absence of any kind of human-caused or natural disturbance, indirect effects would occur from the natural progression of forest growth and change. Fuel loadings are expected to increase over the next decade as natural accumulations and mortality from previous mountain pine beetle and Douglas-fir beetle contribute large wood to the forest floor. The increased surface fuel loads will increase fire intensities. Natural tree regeneration and existing understory trees will continue to grow lowering canopy base heights and adding additional ladder fuels that will increase fires movement from the ground into the canopies. Increases to canopy bulk densities and canopy cover are also expected as mid and overstory trees continue to grow and put on foliar biomass.

The result of these changes would be increased surface and ladder and crown fuels that affect flame length, contribute to the torching of trees, and make crown fire more likely (Peterson et al. 2005; Graham 2004). Fire risk in the project analysis area would likely increase and contribute to severe wildfires that could negatively impact important resources, infrastructure and habitat. Fire return intervals will continue to be missed perpetuating the departure of fire's ecological role in the ecosystem. Vegetation conditions will continue to depart from historic reference conditions increasing the loss of key ecosystem components. Fire suppression will become more difficult and costly as fuels conditions worsen with time. This would increase the likelihood of a crown fire of significant magnitude and intensity that could involve the wildland/urban interface, impact adjacent private lands, Forest Service infrastructure and the West Fork Highway corridor that is used for access and egress by the public and firefighters.

Relevant recent past, current, and reasonably foreseeable future actions adjacent to this area are the Lower West Fork, School Point Ecoburn, Soda Springs Ecoburn and Upper Nez Ecoburn projects. Some of these projects have been completed and others are still in the process of finishing up planned prescribed fire treatments. Modeling shows these previously completed treatments have reduced crown fire potential within the WUI and low severity fire regimes adjacent to private lands. This will provide more favorable conditions during fire suppression in those areas but the potential fire behavior and suppression effectiveness within the Mud Creek project would remain unchanged.

Current and future projects within the Mud Creek project area are the Upper Nez Ecoburn (2,938 acres) which authorizes low and mixed severity fire in the Flat Creek area, and the 2009 & 2013 Forest Wide TSI projects (4,816 acres) which includes stand improvement and fuels activities. A few areas within

Mud Creek treated by these previous projects show potential crown fire behavior because of handpiles that have yet to be burned. Until the residual activity fuels are disposed they will largely offset much of the hazard reduction benefit achieved from the other activities. (Omi, 2010) After the piles are burned these areas would contribute positive changes in fire behavior to the area. The previous projects have collectively modified potential fire behavior by reducing surface, ladder, and crown fuels that break up fuel continuity over the landscape. These changes are evident in the existing condition fire modeling that shows reduced fire behavior within the previous treatments. However, a considerable portion of the project area would remain at high risk for high intensity fire and would still be vulnerable for stand-replacing wildfire under extreme conditions. The previous treatments within the project area are scattered and generally small in size. Without additional adjoining treatments they would have a limited effect on changing fire intensities or type at the landscape scale. Modifications in fire behavior achieved within a single treated stand, however significant, are unlikely to change the area ultimately burned by a large wildfire, aid fire control efforts, or impact the distribution of severities across a landscape. Fuel treatment effectiveness ultimately depends on the cumulative of a treatment regime applied across landscapes and maintained through time. (Omi, 2010)

Previous wildfire disturbance in the analysis area that still show an effect on fire behavior is the 2000 fires that burned a total of 3,072 acres (6% of project area) in the Blue Joint/Little Blue Joint (2,738 acres) and upper reaches of Beavertail Creek 334 acres (<1% of project area) and the 2007 Rombo Fire that burned 1,891 acres (4% of project area) in the Rombo/Line Creek area. Fire severity was primarily stand replacing. Currently, these areas show as surface fire behavior. The majority of the dead trees have fallen to the ground leaving areas with continuous heavy fuels intermixed with thick regeneration that will support active fire spread. As the tree regeneration increases in height these areas will transition to exhibiting crown fire behavior under severe conditions.

Taking no action would cumulatively counteract the recent and past activities that have occurred, offsetting lower wildfire severity effects. Taking no action would decrease fire protection capabilities on lands adjacent to the project area and limit the ability to allow fire to play it's natural role within the adjacent Selway-Bitterroot and Frank Church River of No Return Wilderness Areas. It is also probable that a wildfire occurring within the project area would threaten private lands and residences adjacent to the project boundary.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Fire suppression activities would still occur within the project area to protect timber, wildlife habitat, visuals and private property as directed by the Forest Plan.

The No Action would not achieve the goals of the National Cohesive Wildfire Strategy or the National Fire Plan. Current and future conditions will make it increasingly difficult to meet the Bitterroot National Forest Plan's fire management direction of protection within Management Areas 1, 2 & 3A and Fire Management Units 1 (WUI) and 2 (Roaded). The No Action also wouldn't meet the forest plan direction to use prescribed fire to maintain healthy ecosystems and promote other plan objectives such as protection of timber values, protection and enhancement of wildlife habitat and protection of visual quality. The No Action would not be responsive to the Bitterroot Community Wildfire Protection Plan goals and objectives that identified this area as a high priority for treatment to reduce fuels and the risk of wildfire to the community.

Proposed Action

Effects of Proposed Action

The proposed action would reduce acres of crown fire behavior in low/mixed severity fire regimes within the WUI, community protection zone and warm dry forest types. It would also improve vegetation condition class by creating vegetation and fuel conditions similar to those of historic fire regimes, provide beneficial fire effects by restoring fire to the ecosystem and reduce the risk from wildfire to firefighters and the public. The Proposed Action would reduce the likelihood for negative effects from wildfires affecting National Forest System lands and adjacent private property within the project area by reducing the continuity of fuels and creating landscape diversity. Following implementation of the proposed action, fire (wildfire and prescribed fire) can then be safely and successfully used within this fire dependent ecosystem to maintain desired landscape conditions. The changed fuel and fire behavior conditions within the project area will also increase the opportunity for allowing natural fire to play its ecological role within the adjacent Selway-Bitterroot, Frank Church River of No Return Wildernesses and Blue Joint Wilderness Study Area. This is due to a decreased transfer of risk and increased opportunities the treated areas provide for containing a fire prior to reaching values at risk.

Proposed vegetation and fuels treatments are expected to reduce surface, ladder and crown fuels and change the fuel model profile. This reduces flame lengths and crown fire potential, allowing firefighters greater success in protecting important forest resources and other values within and adjacent to the project area. By treating areas, specifically those comprised of warm dry forests associated with Fire Regime I, they would become more resilient to stand-replacing wildfire. Fire suppression and protection of Forest Service and private values within the WUI and community protection zone would be successful under most conditions because of the reduced fire intensities and fire type. The ability of firefighters to safely and effectively suppress wildland fire would be improved with these treatments. Commercial and non-commercial treatments would help set the stage to safely and effectively introduce prescribed fire that will reduce the amount of surface fuels and fuel continuity. Prescribed fire would also improve vegetation conditions class and move treated areas closer to the desired conditions representative of historic fire regimes. Progress would be made towards the restoration of ecological processes that include the reintroduction of fire to the landscape.

This Proposed Action would change fire type across the project area by moving 17,067 acres from crown fire to surface fire. Treatments would reduce fire intensities to less than 4 feet on 35,067 acres improving firefighter safety and fire managers the ability to follow Forest Plan direction requiring protection of values at risk with prompt, aggressive control of wildfires. The Proposed Action would implement recommendations from the Bitterroot Community Wildfire Protection Plan by reducing fuels and changing fire behavior in priority 1 and 3 areas. Implementation of the Proposed Action would meet all three National Cohesive Strategy goals. Treatments would reduce crown fire potential and move conditions closer to those of their historic fire regimes allowing the landscape to be more resilient to fire disturbances. The Proposed Action moves the area closer to the goal of making fire adapted communities resilient to loss from wildfire by reducing fuels and changing fire behavior within the WUI and community protection zone. Lastly, it will improve wildfire response by providing less hazardous conditions for firefighters (reduced fire intensities, reduced hazard trees), increasing fire management options and success by creating large continuous areas with reduced fuel loads and continuity. The Proposed Action also responds to the National Fire Plan goals of reducing hazardous fuels to modify current fire behavior.

The potential fire type and intensity below is based on fuel conditions following the implementation of the proposed action within the project area. An updated disturbance layer was created to simulate the proposed activities and adjustments to the existing vegetation cover input was made based on the anticipated changes from implementing those activities. The Landfire Total Fuel Change Toolbar (LFTFCT) used these layers to make adjustments to the landscape vegetation and fuels and produce the landscape file. Inputs used for fuel moistures and weather parameters typical of severe conditions are found in Table 2. Flammap was used to produce the outputs using the proposed action landscape file.

Table 11: (Post Treatment Conditions- Potential Fire Type, Flame Lengths & Rate of Spread)

Fire Type	Acres (% of Project Area)	Acres within Wildland Urban Interface (% of WUI)	Acres within Community Protection Zone (% of CPZ)	Acres within Warm-Dry Forest Types (% of Warm Dry)
No Fire (non-burnable)	563 (1%)	217 (1%)	375 (1%)	306 (1%)
Surface Fire	39,322 (81%)	16,243 (78%)	28,179 (80%)	25,774 (81%)
Passive Crown Fire	8,599 (18%)	4,371 (21%)	6,649 (19%)	5,798 (18%)
Active Crown Fire	7 (<1%)	7 (<1%)	7 (<1%)	1 (<1%)
Flame Length (Feet)	**Acres (% of Project Area)**	**Acres within Wildland Urban Interface (% of WUI)**	**Acres within Community Protection Zone (% of CPZ)**	**Acres within Warm-Dry Forest Types (% of Warm Dry)**
0-4	35,553 (73%)	14,802 (71%)	25,318 (72%)	23,078 (72%)
4-8	9,376 (19%)	3,925 (19%)	6,911 (20%)	6,386 (20%)
8-11	1,346 (3%)	671 (3%)	1,064 (3%)	989 (3%)
11+	2,216 (5%)	1,440 (7%)	1,916 (5%)	1,426 (5%)
Rate of Spread (Chains/Hour)	**Acres (% of Project Area)**	**Acres within Wildland Urban Interface (% of WUI)**	**Acres within Community Protection Zone (% of CPZ)**	**Acres within Warm-Dry Forest Types (% of Warm Dry)**
0-5	20,149 (41%)	8,186 (39%)	13,415 (38%)	13,557 (43%)
5-10	9,813 (20%)	4,236 (20%)	7,503 (21%)	6,358 (20%)
10-20	9,682 (20%)	4,179 (20%)	7,342 (21%)	5,705 (18%)
20-40	6,183 (13%)	2,866 (14%)	4,748 (13%)	4,173 (13%)
40+	2,664 (5%)	1,371 (7%)	2,203 (6%)	2,087 (7%)

Effects of Commercial Harvest

Commercial harvest activities (regeneration and intermediate) using mechanical methods to improve forest resiliency, reduce fuels and modify vegetation composition and structure are proposed on up to 13,700 acres. Effects of these treatments on fuels are reduced canopy cover, reduced canopy bulk densities, increased canopy base heights and a decrease in fuel loadings. Depending on the specific vegetation management activity prescribed, the estimated reductions to canopy cover may range from 30-100%. Reducing canopy cover will also reduce canopy bulk densities between 30-100% making it difficult for fire to sustain itself in the crowns due to the discontinuity of canopy fuels thus reducing the probability of crown fire. Removing ladder fuels and less fire tolerant tree species will also raise canopy base heights by 10-30' reducing the potential for torching to initiate. This will be accomplished from harvest and with follow-up non-commercial thinning and prescribed fire. Omi found that thinning treatments have demonstrated the most substantial reductions in wildfire severity, but only by those that produce substantial changes to canopy fuels. (Omi, 2010)

Regeneration harvests larger than 40 but less than 200 contiguous acres may be utilized in Management Areas 1 and 2. Openings of this size, mimic natural disturbance patterns common to mixed severity or stand replacing fire regimes. Historically these openings would have been present on the landscape in the Mud Creek area, especially in areas dominated by cool moist forest types (26% of the project). The lack of fire on the landscape has reduced the varied patch size and patterns that naturally would have occurred. Fewer fires have led to less diversity in stand ages and successional stages across the landscape. Without the varied patch size and patterns historically created by fire across the landscape, wildfires are burning with greater intensity over larger areas and insects and diseases can spread further with the increase in older and denser stands.

Implementing regeneration harvests up to 200 acres in size will contribute to landscape diversity, mimic natural disturbance patterns, and reduce fuel continuity. This will remove insect and disease affected stands, prone to torching and crown fire behavior. Complete removal of the canopy and ladder fuels followed by site preparation burning will reduce most of the burnable fuels from these areas. Following implementation, these areas will not be able to support crown fire and will serve as barriers to fire spread. Depending on location, and prior to establishment of regeneration, these areas may also serve as safety zones during wildfire suppression.

Removing dead and dying trees from past or current insect mortality (mountain pine beetle, Douglas-fir beetle and/or western spruce budworm) will prevent increases in large fuels from accumulating over the next decade within treatment areas (Jenkins, 2013). Removing the majority of the dead trees will improve firefighter safety by reducing fire intensities, removing potential hazard trees, improving fireline construction capabilities, improving access/egress to future wildfires in the area and improving the probability of success during initial attack which minimizes exposure of additional firefighters to hazardous conditions.

Commercial harvest activities will create conditions where prescribed fire can be safely used to reduce and maintain surface fuel loadings in treated areas that are within desired ranges for the representative fire group. Maintaining surface fuels and coarse woody debris (CWD) within historic ranges will reduce fire severity and impacts to soils from long duration burning of large wood.

Effects of Non-Commercial Activities

Non-commercial activities such as stand improvement- thinning and slashing and piling of fuels are proposed on up to 26,282 acres. These activities would occur in areas following commercial harvest, within established plantations regenerated from previous management, within the WUI and/or areas of warm dry forest. These areas were identified during the fuels prioritization process (PF-FIRE-002). Thinning activities will reduce tree densities, promote desired species composition favoring fire tolerant species, remove ladder fuels raising canopy base heights (5-15'). Piling and pile burning is effective at reducing surface fuel loadings created from either natural fuel accumulations due to missed fire cycles or fuels generated from other activities. Piling is commonly used in conjunction with thinning to remove fuels and moderate fire behavior prior to using other types of prescribed fire. The changes to fuels from non-commercial activities will reduce fire behavior and the likelihood of initiating tree torching that could carry fire up into the canopy. Agee and Skinner (2005) summarize guidelines for treating wildland fuels with thinning. They offer four principles for creating fire-resilient stands in dry forests: reduce surface fuels, increase the height to the canopy, decrease crown density, and retain big trees of fire-resistant species (Reinhardt et al., 2008). Thinning for fire hazard reduction should concentrate, in general, on the smaller understory trees to reduce vertical continuity between surface fuels and the forest canopy. In many cases the overstory can be left intact, although in some cases it may be desirable to reduce the horizontal continuity of the canopy as well by thinning some bigger trees (Reinhardt et al., 2008).

Although non-commercial activities are effective as standalone treatments at reducing surface fuels, raising canopy base heights and reducing the potential for torching, it is expected that there will be lesser effect on reducing fire behavior compared to the areas that are treated commercially. The reduced effectiveness is because these treatments create little change to the canopy cover and canopy bulk densities without removing many mid-sized trees. Although crown fire is less likely to initiate, especially following implementation of prescribed fire, areas with dense continuous crowns can still support active crown fire under severe, windy conditions.

Effects of Prescribed Fire Activities

Prescribed Fire- Site Preparation is proposed for all areas that are prescribed a regeneration harvest, up to 4,800 acres. This is a moderately intense fire that removes the majority of the remaining onsite vegetation, reduces residual surface fuels and creates areas of bare soil. This reduces competition and creates suitable microsites for successful regeneration. Areas treated with this activity generally will not support active fire spread following treatment due to the lack of surface and canopy fuels.

Prescribed Fire- Low Severity and Maintenance is proposed on up to 28,235 acres, primarily within areas dominated by warm dry forest types. It is intended to mimic natural fire that historically burned frequently with low intensities (Arno, 1976 & 1983, Fryer, 2016). Effects of low severity fire would be reduced surface fuels and fuelbed continuity, an increase of canopy base heights (5-15’) from crown scorch and small tree mortality. Anticipated canopy cover reductions will generally be less than 25%. These changes will reduce fire intensities and the likelihood of crown fire. Maintenance burning will be used to maintain desired fuel loadings, control understory vegetation and maintain fire return intervals appropriate for each fire regime. Re-treatment or other maintenance of treated areas will be necessary for continued effectiveness. Landscape-scale prescribed burning and maintenance of treated areas must be part of long term vegetation and fuel treatment strategies, and the need for maintenance treatments will continue to escalate as more lands are restored. (Hudak, 2011)

Prescribed Fire- Mixed Severity is proposed on up to 12,125 acres within areas dominated by cool moist forest types and areas of transitional forest, following previous wildfire, that naturally would have experienced mixed or stand replacing fire (Fire Regimes III-V). Mixed severity fire would mimic the effects of natural fire under controlled conditions reducing the potential for negative effects to adjacent values that are sensitive to fire. Mixed severity fire would create a mosaic of burn patterns ranging from patches of mortality to areas left unburned. Canopy cover reductions will range between 25-75% depending on how the existing fuels, vegetation and topography align to affect fire behavior. These fire effects will create breaks in both surface and canopy fuels and provide diversity the landscape increasing the resilience to future disturbances (fire or insects). These changes will yield reduced fire intensities and a lower likelihood of crown fire impacting a large area.

All prescribed fire activities will reduce surface fuels, reintroduce fire to a fire dependent ecosystem and move areas closer to the desired conditions for each fire regime and fire group. Effects of prescribed burning are the consumption of surface fuels resulting in reduced fuel loadings that are variable across treated areas and the landscape but within historic ranges for each fire group. Prescribed fire will also create a discontinuous fuelbed that will reduce potential fire intensities and spread. Canopy base heights will be raised and ladder fuels removed by thinning from mortality of understory and intermediate sized trees. Desirable scorching on residual tree's lowest limbs will also further raise canopy base heights and reduce the probability of torching during a wildfire. Overall changes to surface and canopy fuels from prescribed fire will result in reduced fire type and intensity. Site specific burn plans will be devolved and implemented under specific weather and fuel moisture conditions designed to meet the desired conditions.

Areas on national forest lands treated by activities proposed in this project would have reduced flame lengths, fire intensity, rates of spread and crown fire potential following implementation. Research shows that with a few exceptions, fuel treatments substantially moderated fire severity and reduced tree mortality (Safford, 2009). Treatments that include surface fuel reduction, particularly by prescribed burning, are well supported for moderating potential wildfire behavior in both long-needle pine and mixed conifer forests. These treatments appear to remain effective for up to ten years, but longevity should be expected to vary by ecosystem productivity (Omi, 2010). The rate of forest fuels accumulation varies as a function of forest type, climate, and disturbance regime, particularly fire disturbance. Additionally, to achieve desired effects in tempering fire behavior at a landscape scale, land managers must apply optimally placed treatments at a rate of 1% to 2% on their land base per year (Finney, 2007).

Scientific findings indicate the most appropriate fuel treatment strategy is often thinning (mechanical treatments that remove ladder fuels and decreasing crown density) followed by piling and burning fuels, and prescribed fire. These treatments would provide maximum protection from severe fires in the future (Peterson et al. 2005). Stephens found that when they are applied, both prescribed fire and its mechanical surrogates are generally successful in meeting short-term fuel-reduction objectives and in changing stand structure and fuel beds such that treated stands are more resistant and resilient to high-intensity wildfire (Stephens, 2012). Other research shows that areas treated before a fire begins can decrease severity (Strom and Fule 2007; Peterson 2007; Omi and Martinson 2002 & 2004; Agee and Skinner 2005; Graham 2004 & 2009; Pollet and Omi 2002; Fule et al. 2001; Hudak et al, 2011; Prichard et al. 2020). In extreme weather conditions, such as drought and high winds, fuel treatments may do little to mitigate fire spread or severity (Pollet and Omi 2002). However, it is still expected that the area treated would have reduced fire behavior and effects compared to untreated areas (Prichard, 2020).

Post Treatment Fuel Models

Changes to fuel models were made based on the existing vegetation type and the effects the proposed treatments would have on those types. After the implementation of all vegetative and prescribed fire treatments within the Proposed Action the following fuel models would be present within the project area. These fuel models were used as inputs for fire behavior modeling of the proposed action.

Table 12: (Post Treatment Fuel Models)

Fuel Model	Acres (% Project Area)	Changed Acres
NB 8 (98) open water	49 (<1%)	1
NB 9 (99) bare ground	514 (1%)	75
GR1 (101) short, sparse dry climate grass	5,417 (11%)	5,371
GR2 (102) low load, dry climate grass	4,694 (10%)	-2,434
GR4 (104) moderate load, dry climate grass	7 (<1%)	-3
GS1 (121) low load, dry climate grass-shrub	15,355 (32%)	14,563
GS2 (122) moderate load, dry climate grass-shrub	2,157 (4%)	-13,819
SH1 (141) low load, dry climate shrub	1,653 (3%)	-2,209
SH2 (142) moderate load, dry climate shrub	227 (<1%)	96
SH3 (143) moderate load, humid climate shrub	1 (<1%)	1
SH5 (145) high load, dry climate shrub	1 (<1%)	-4
SH7 (147) very high, dry climate shrub	0 (0%)	-20
TU1 (161) low load, dry climate timber-grass-shrub	7,423 (15%)	3,367
TU2 (162) moderate load, humid climate timber-shrub	2,472 (5%)	2,005
TU5 (165) very high load, dry climate timber-shrub	105 (<1%)	-106
TL1 (181) low load conifer litter	3,944 (8%)	3,834
TL3 (183) moderate load conifer litter	681 (1%)	-913
TL5 (185) high load conifer litter	3,461 (7%)	-6,002
TL6 (186) moderate load broadleaf litter	21 (<1%)	-65
TL8 (188) long needle litter	309 (1%)	-3,738

The direct effect from the changes in fuel models is a reduction in flame length and rate of spread caused from reduced fuel loads and changes in fuel continuity. Changes to the surface fuels represented by these models when combined with changes in canopy fuels leads to reduced acres exhibiting crown fire behavior within treated areas. Reductions in surface fuels, especially in the larger size classes, will also increase fireline production rates by initial attack resources. Increased production rates when combined with reduced rates of spread will increase the probability of success in suppressing future wildfires in the area.

Post Treatment Fire Behavior

Fire behavior was modeled based on the anticipated post treatment conditions for surface fuels, stand composition, and structure to evaluate potential changes between the existing conditions and the proposed action on flame lengths, crown fire and rate of spread. The changes to the indicators were then evaluated against the components of the purpose and need specific to fire and fuels to gauge the level of success the proposed action has in meeting those goals.

Effects within Project Area

Model results are summarized in Tables 13-16 and displayed in Figures 13-16. The proposed action would result in the following improvements in potential fire behavior characteristics across the entire project area: a 17,068 acre (36%) increase in acres exhibiting reduced fire type (non-burnable and surface), a 35,067 acre (72 %) increase in areas with flame lengths less than 4 feet, and a 5,465 acre (11%) increase of acres with a rate of spread at 10 chains per hour or less. These results show an improvement in all three indicators that were identified to measure effects and the degree to which the proposed action meets the purpose and need of the project.

Table 13: (Comparison of potential fire behavior characteristics within the project area)

Potential Fire Behavior Characteristic	No Action		Proposed Action		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Fire Type						
Non Burnable	486	1%	563	1%	77	+ <1%
Surface	22,331	46%	39,322	81%	16,991	+ 35%
Passive Crown	25,618	53%	8,599	18%	-17,019	- 35%
Active Crown	55	<1%	7	<1%	-48	- <1%
Flame Length (Feet)						
0-4’	486	1%	35,553	73%	35,067	+ 72%
4-8’	20,082	41%	9,376	19%	-10,706	- 22%
8-11’	18,031	37%	1,346	3%	-16,685	- 34%
11’+	9,892	20%	2,216	5%	-7,676	- 15%
Rate of Spread (Chains/Hour)[1]						
0-5	17,515	36%	20,149	41%	2,634	+ 5%
5-10	6,982	14%	9,813	20%	2,831	+ 6%
10-20	9,573	20%	9,682	20%	109	0%
20-40	9,918	20%	6,183	13%	-3,735	- 7%
40+	4,502	9%	2,664	5%	-1,838	- 4%
[1] 1 chain = 66 feet.						

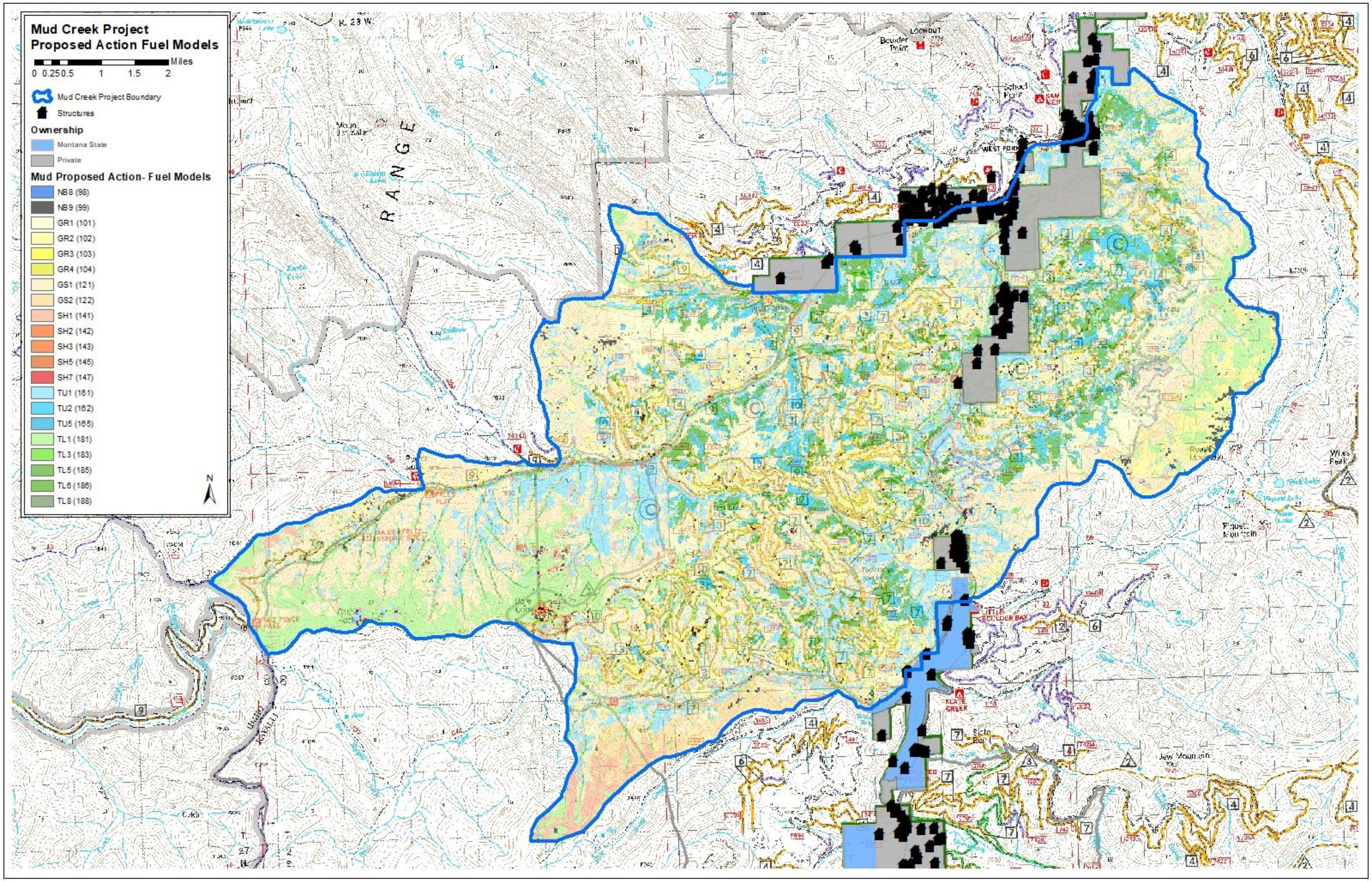

Figure 12. (Proposed Action Fuel Models)

After treatment non-burnable or surface fire is expected to occur on 39,885 acres (82%) within the project area. Surface fire will limit the probability of spotting that causes control problems during fire suppression and reduces the amount of crown foliage consumed lowering the probability of vegetation mortality during a future wildfire. Increasing the areas that would burn as surface fire also moves those areas closer to conditions representative of the historic fire regimes and fire groups within the project area.

Following implementation of the proposed action, 35,553 acres (73%) of the project area will have flame lengths less than 4 feet. Within these areas, under most conditions, firefighters will be able to use hand tools and direct attack tactics to suppress wildfires. This will improve their safety and should decrease potential fire size by avoiding indirect tactics.

Rates of spread following treatments also show improved conditions as 5,465 acres (11%) of the two highest categories were moved into slower categories. These improvements will improve firefighter's ability to contain a wildfire during initial attack with less resources than would be needed with faster rates of spread. These changes also show that overall the proposed treatments are not increasing rate of spread. Pollet and Omi (2002) reasoned that treatments that reduced density and increased average tree diameter outweighed any increase in micro-climate effects, suggesting that the degree of forest openness was not enough to sufficiently increase fire behavior and, thus post fire effects (Hudak, 2011). Pollet and Omi (2002) also state:

> *Fuel moistures may be affected by microclimate and probably vary between the untreated and treated stands. A more open stand allows more wind and solar radiation, resulting in a drier microclimate compared to a closed stand. A drier microclimate generally contributes to more severe fire behavior. However, our study does not support the assertion that more open stands experience higher fire severity. More open stands had significantly lower fire severities compared to the more densely stocked untreated stands in this study. The degree of openness in the studied treated stands may not have been sufficient to increase fire activity.*

Some areas might still burn with a higher rate of spread post treatment but with much lower fire intensities which is part of the desired conditions for this project. Scott (2003) found that canopy fuel treatments may reduce the potential for crown fire at the expense of slightly increased surface fire spread rate and intensity. However, critical levels of fire behavior (limit of manual or mechanical control) are less likely to be reached in stands treated to withstand crown fires, as all crown fires are uncontrollable. Though surface intensity may be increased after treatment, a fire that remains on the surface beneath a timber stand is generally controllable (Scott 2003).

Effects within WUI

After treatment, non-burnable or surface fire is expected to occur on 16,460 acres or 79% of the project WUI. Implementing the proposed action will reduce crown fire behavior on 6,882 acres or 33%. Flame lengths predicted to be less than 4' will increase by 14,585 acres or 70%. Reductions in rate of spread will also occur on 2,731 acres or 13%. These positive changes to potential fire behavior will increase the probability of success of fire suppression actions within the WUI, provide safer conditions for firefighters and the public during a fire, limit negative effects to onsite values (visuals, timber, infrastructure and habitat) and reduce the potential for negative impacts from fire to the West Fork community. The proposed action meets the purpose and need of reducing fire behavior within the WUI.

Table 14: (Comparison of potential fire behavior characteristics within WUI)

Potential Fire Behavior Characteristic	No Action		Proposed Action		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Fire Type						
Non Burnable	207	1%	217	1%	10	+ <1%
Surface	9,367	45%	16,243	78%	6,876	+ 33%
Passive Crown	11,224	54%	4,371	21%	-6,853	- 33%
Active Crown	36	<1%	7	<1%	-29	- <1%
Flame Length (Feet)						
0-4’	217	1%	14,802	71%	14,585	+ 70%
4-8’	8,177	39%	3,925	19%	-4,252	- 20%
8-11’	7,445	36%	671	3%	-6,774	- 33%
11’+	4,999	24%	1,440	7%	-3,559	- 17%
Rate of Spread (Chains/Hour)[1]						
0-5	7,382	35%	8,186	39%	804	+ 4%
5-10	2,579	12%	4,236	20%	1,657	+ 8%
10-20	3,909	19%	4,179	20%	270	+1%
20-40	4,512	22%	2,866	14%	-1,646	- 8%
40+	2,456	12%	1,371	7%	-1,085	- 5%
[1] 1 chain = 66 feet.						

WUI/Home Ignition Zone Issue

The purpose of the Mud Creek Project is to reduce the potential for crown fire behavior within the Wildland Urban Interface, community protection zone and in low severity fire regimes to improve forest resilience to natural disturbance factors such as fire, insects and disease. While removing fuel from within the Home Ignition Zone is recommended and encouraged to reduce the probability a home would burn during a wildfire, it is not enough to meet the purpose and need within the project area. Preventing negative impacts to communities and the loss of homes from wildfire is important, and is a goal of the Cohesive Strategy, however, only treating the home ignition zone will not reduce firebrand production from torching. It is well understood and supported that the immediate area surrounding a home and the characteristics of the building material are potentially the most critical elements in determining its survivability. The Forest Service encourages homeowners to do their part in making their homes fire safe, however, hardening structures on private land is beyond the scope and scale of this project. The Bitterroot National Forest continues to work with our local fire districts and the Bitterroot RC&D to promote the FIREWISE and Fire In the Root programs to local landowners in order to create homes and communities that are resilient to wildfire.

While Cohen’s research has shown individual home-by-home treatments can help reduce the risk of loss of individual homes, relying solely on such treatments would forego strategic opportunities for reducing fire behavior and controlling fires within the wildland urban interface or community protection zone prior to fire impacting structures. Additionally, reducing fire behavior and the potential for torching within the WUI will also reduce the potential for lofted firebrands which Cohen has identified as a principle ignition factor for structures. Highly ignitable homes can ignite during a wildland fire without a fire spreading near the structure. Firebrands that result in ignitions can originate from wildland fires that are a distance of 1 kilometer (0.6 miles) or more (Cohen 2000).

Treatments would reduce fire intensity and crown fire potential on national forest lands, but may not directly protect all homes. Studies indicate that wildfire mitigation focused on structures and their immediate surroundings is the most effective at reducing structure ignitions (Cohen 1999, 2000, 2002; Scott 2003). Treatment activities within the proposed action would complement treatments being proposed on and currently occurring on private lands. While individual home-by-home treatments can help reduce the risk of loss of individual homes, relying solely on such treatments would forego strategic opportunities for controlling fires within the wildland urban interface area and protecting other values at risk. As mentioned under the No Action, without further fuels treatment it will become increasingly difficult to successfully suppress wildfires on national forest lands with prompt, direct, aggressive control as directed by the forest plan.

Although homes in the path of a wildfire are perhaps the most immediately recognized value at risk, research has determined that treatments need to go beyond the home ignition zone for other resource values (Graham 2004). While changing fire behavior in the WUI to improve firefighter and public safety, protect values and increase probabilities of success during suppression are important outcomes from the proposed treatments, increasing landscape diversity, resilience to fire along with preventing the loss of key ecosystem components from fire effects that are predicted to be outside of historic characteristics for low fire regimes are just as important. Research shows that with a few exceptions, fuel treatments substantially moderated fire severity and reduced tree mortality (Safford, 2009). Safford (2009) also concluded that “in most cases, crown fire was reduced to surface fire within 50 m of the fuel treatment boundary; when combined with other considerations, we conclude that 400–500 m appear to be a reasonable minimum width for most WUI fuel treatments”. Proposed treatments will extend beyond the recommended 500 meters from the private land boundary to help meet the other project goals besides WUI/community protection. However, treatments in these areas will also benefit WUI protection by creating favorable conditions along the existing road network that could be used for potential control lines during a wildfire. The prevailing winds, topographic influences and road locations within the WUI of this area create limitations for suitable control locations to keep fire off private land. Having good defensible locations for control lines in place prior to a wildfire will improve the probability of success of keeping fire from impacting private land and other susceptible values in the area.

A study conducted by Graham et al. (2009) on wildfires during the summer of 2007 that burned over 500,000 acres within central Idaho showed that limited loss of structures and resource damage was largely due to the existence of fuel treatments and how they interacted with suppression activities. In addition to modifying wildfire intensity, the burn severity to vegetation and soils within the areas where the fuels were treated was generally less compared to neighboring areas where the fuels were not treated. They noted that by modifying the fire’s behavior, the fuel treatments presented suppression opportunities that otherwise may not have been available. These opportunities included providing locales to conduct burnouts to locating both hand and machine constructed firelines. In particular, the mechanical fuel treatments were very effective in creating conditions where surface fires dominated. Because of the lower intensity observed in these areas, they often provided safe zones for firefighters and crews were able to readily suppress the numerous spot fires that often occurred. Their observations suggest fuel treatments that create irregular forest structures and compositions, both within and among stands, tend to produce wildfire resilient forests.

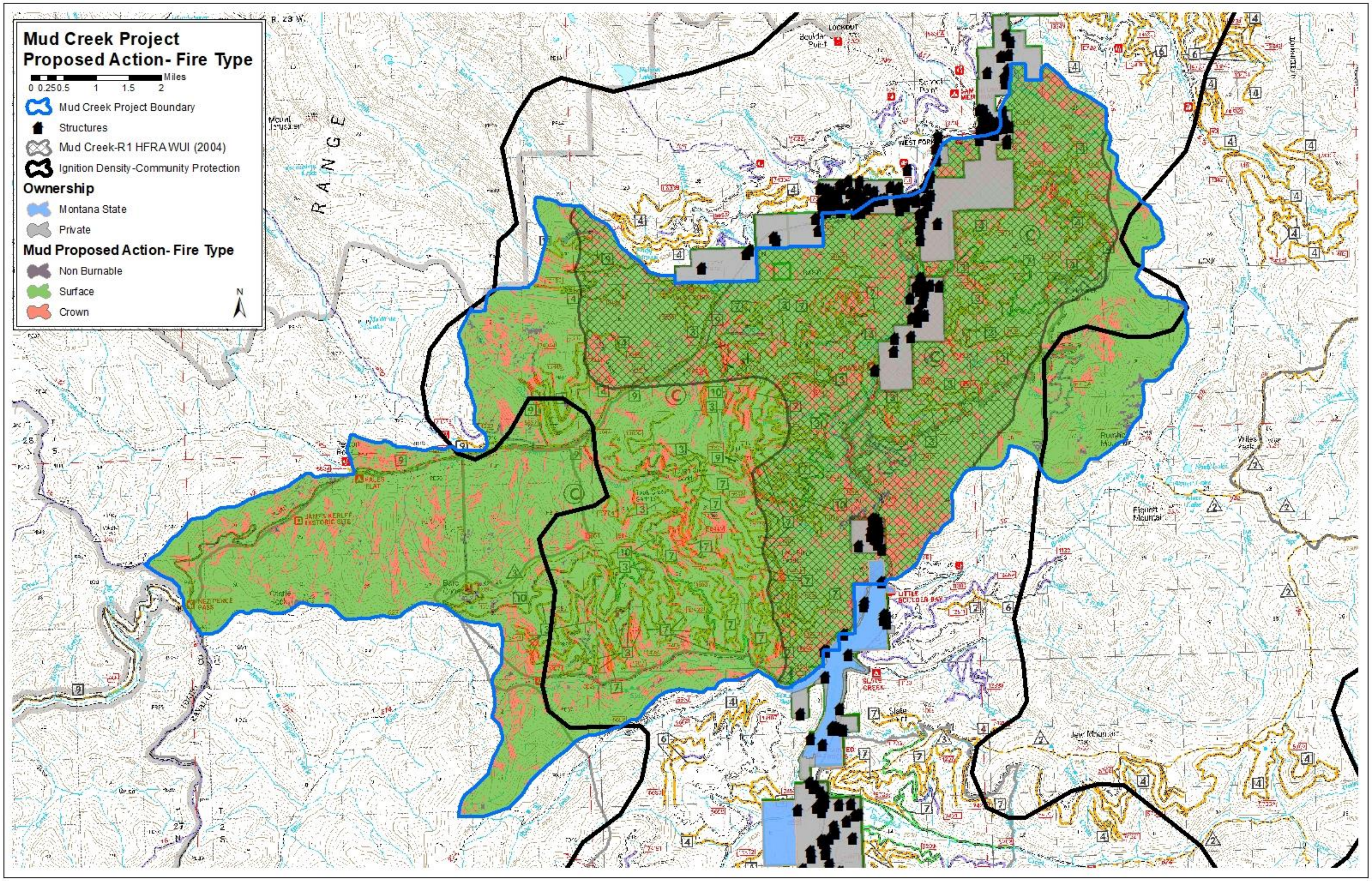

Figure 13. (Proposed Action Fire Type)

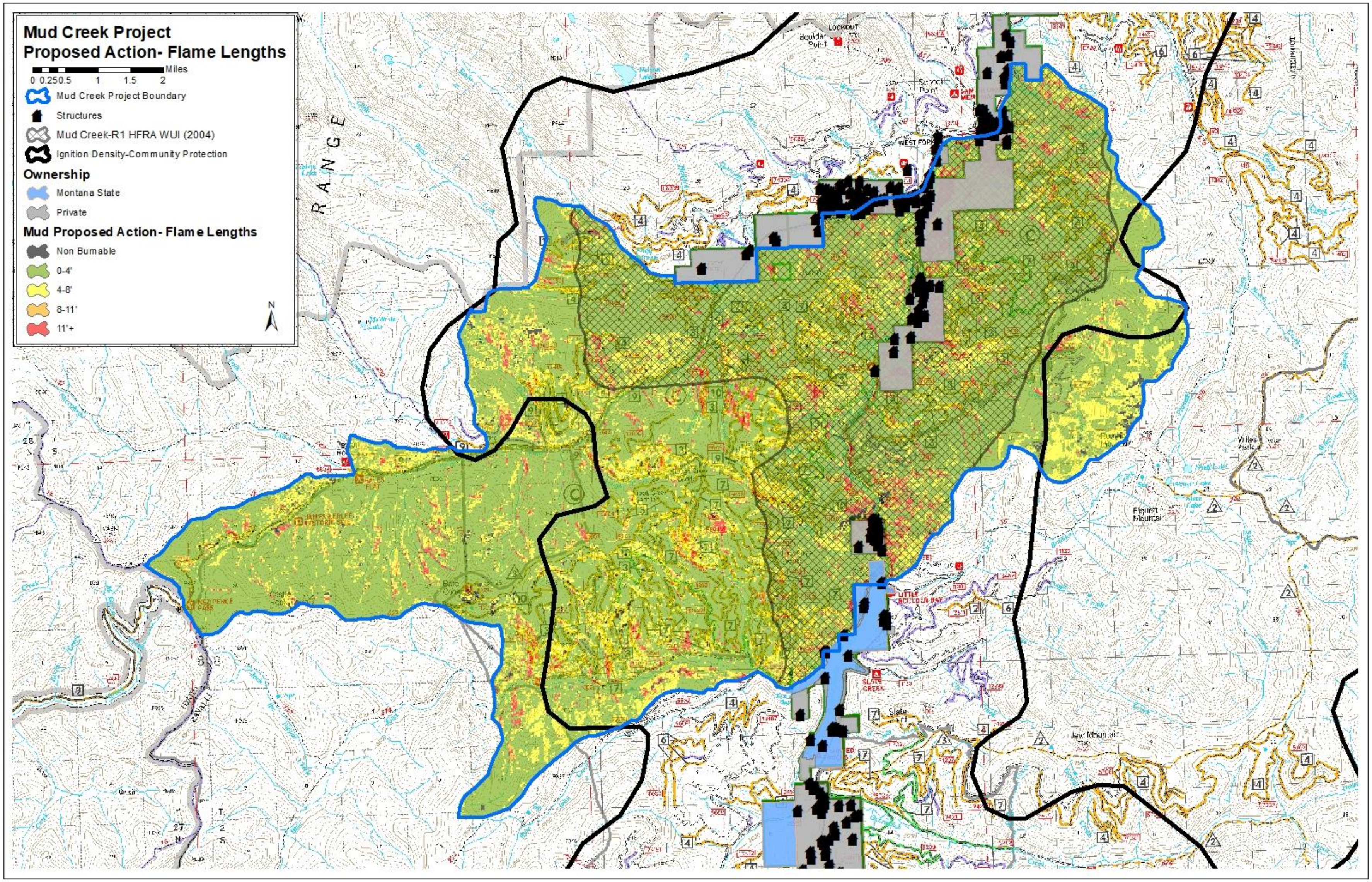

Figure 14. (Proposed Action Flame Lengths)

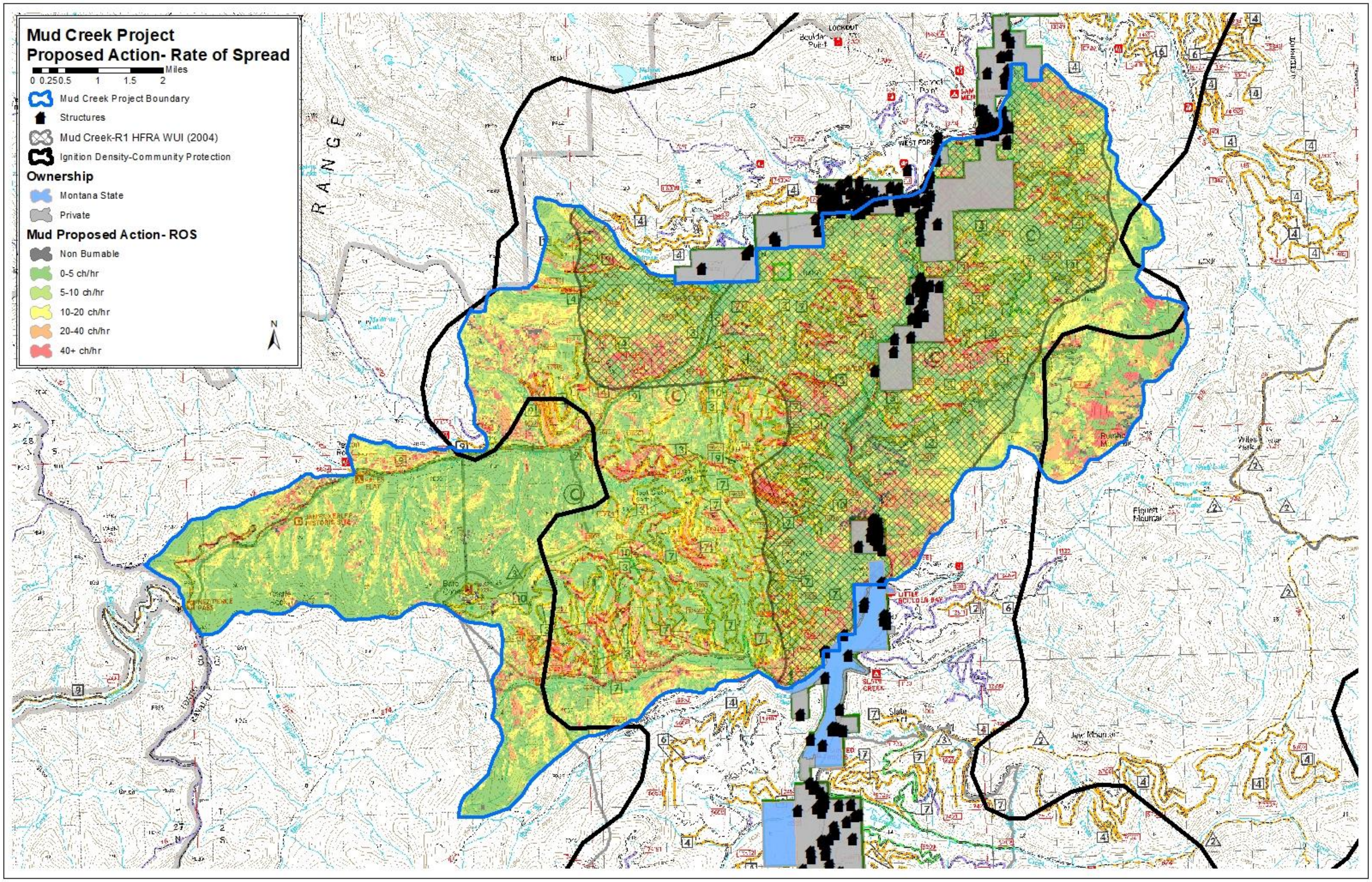

Figure 15. (Proposed Action Rate of Spread)

Effects within Community Protection Zone (CPZ)

After treatment, non-burnable or surface fire is expected to occur on 28,554 acres or 81% of the project CPZ. Implementing the proposed action will reduce crown fire behavior on 12,328 acres or 36%. Flame lengths predicted to be less than 4' will increase by 24,952 acres or 71%. Reductions in rate of spread will also occur on 4,542 acres or 12%. These positive changes to potential fire behavior will increase the probability of success of fire suppression actions within the CPZ, provide safer conditions for firefighters and the public during a fire, limit negative effects to onsite values (visuals, timber, infrastructure and critical habitat) and reduce the potential for negative impacts from fire to the West Fork community. The positive changes to fire behavior and breaks in fuel continuity across the landscape will also provide increased opportunities to contain fires beyond initial attack. This would reduce the likelihood that fires originating within the CPZ will reach adjacent communities. The proposed action meets the purpose and need of reducing fire behavior within the CPZ.

Table 15: (Comparison of potential fire behavior characteristics within the Community Protection)

Potential Fire Behavior Characteristic	No Action		Proposed Action		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Fire Type						
Non Burnable	366	1%	375	1%	9	+ <1%
Surface	15,860	45%	28,179	80%	12,319	+ 35%
Passive Crown	18,939	54%	6,649	19%	-12,290	- 35%
Active Crown	44	<1%	7	<1%	-37	- <1%
Flame Length (Feet)						
0-4'	366	1%	25,318	72%	24,952	+ 71%
4-8'	13,501	38%	6,911	20%	-6,590	- 18%
8-11'	13,570	39%	1,064	3%	-12,506	- 36%
11'+	7,773	22%	1,916	5%	-5,857	- 17%
Rate of Spread (Chains/Hour)[1]						
0-5	11,902	34%	13,415	38%	1,513	+ 4%
5-10	4,794	14%	7,503	21%	2,709	+ 7%
10-20	7,022	20%	7,342	21%	320	+ <1%
20-40	7,729	22%	4,748	13%	-2,981	- 9%
40+	3,763	11%	2,203	6%	-1,560	- 5%
[1] 1 chain = 66 feet.						

Effects within Low Severity Fire Regimes/Warm-Dry Forest Types

After treatment, non-burnable or surface fire is expected to occur on 26,080 acres or 82% of the warm dry forest types found within the project area. Implementing the proposed action will reduce crown fire behavior on 12,031 acres or 39%. Flame lengths predicted to be less than 4' will increase by 22,773 acres or 71%. Reductions in rate of spread will also occur on 5,497 acres or 18%. These positive changes to potential fire behavior will reduce the acres of stand replacing fire that is not typical or desirable within these forest types based on their low severity, high frequency fire regime, fire groups and other findings from local research. Reduced fire behavior and improved vegetation conditions will limit the potential for loss of key ecosystem components. Reduced fire behavior will provide resilience of these forest types to disturbance processes on the landscape. Conditions following treatment will allow for fire (prescribed and wildfire) to be used on the landscape to maintain desired conditions, natural processes and landscape diversity.

Table 16: (Comparison of potential fire behavior characteristics within the Warm-Dry Forest Types)

Potential Fire Behavior Characteristic	No Action		Proposed Action		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Fire Type						
Non Burnable	305	1%	306	1%	1	+ <1%
Surface	13,744	43%	25,774	81%	12,030	+ 38%
Passive Crown	17,801	56%	5,798	18%	-12,003	- 38%
Active Crown	29	<1%	1	<1%	-28	- <1%
Flame Length (Feet)						
0-4’	305	1%	23,078	72%	22,773	+ 71%
4-8’	11,520	36%	6,386	20%	-5,134	- 16%
8-11’	12,836	40%	989	3%	-11,847	- 37%
11’+	7,218	23%	1,426	5%	-5,792	- 18%
Rate of Spread (Chains/Hour)[1]						
0-5	10,259	32%	13,557	43%	3,298	+ 11%
5-10	4,159	13%	6,358	20%	2,199	+ 7%
10-20	6,342	20%	5,705	18%	-637	- 2%
20-40	7,383	23%	4,173	13%	-3,210	- 10%
40+	3,737	12%	2,087	7%	-1,650	- 5%
[1] 1 chain = 66 feet.						

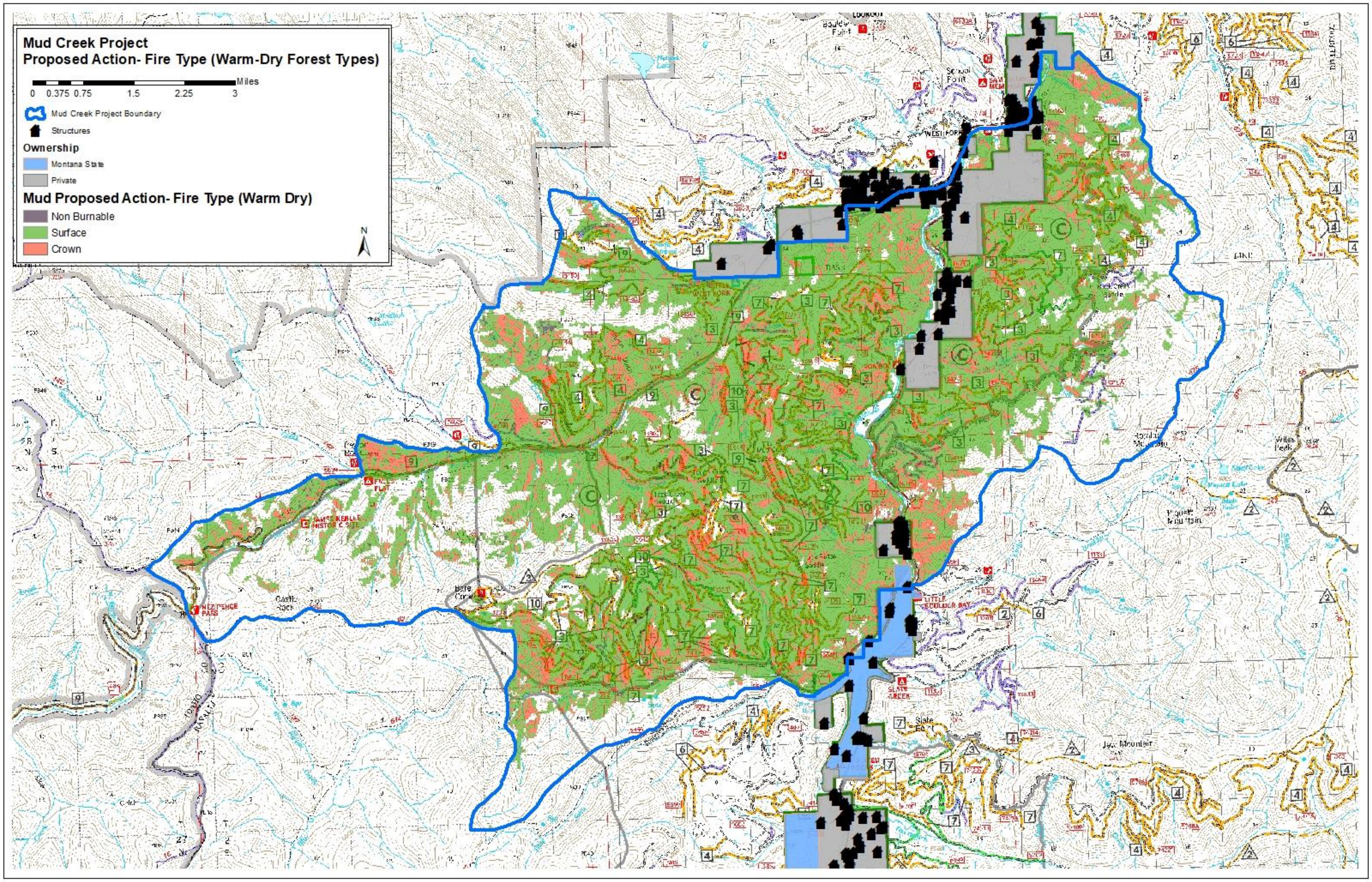

Figure 16. (Proposed Action- Fire Type (Warm Dry Forest Types))

Climate Change

Over the last several decades, the US has witnessed a marked increase in large wildfire frequency and duration with the greatest increases observed in the temperate coniferous forests of the Northern Rocky Mountains. These trends are widely attributed to shifts towards earlier snowmelt timing. Results extend these findings by demonstrating that areas with the most significant change in fire weather season length occur where not only temperature but also changes in humidity, length of rain-free intervals and wind speeds are most pronounced (Jolly, 2015).

The overall importance of climate in wildfire activity underscores the urgency of ecological restoration and fuels management to reduce wildfire hazards to human communities and to mitigate ecological impacts of climate change in forests that have undergone substantial alterations due to past land uses. Regardless of past trends, virtually all climate-model projections indicate that warmer springs and summers will occur over the region in coming decades. These trends will reinforce the tendency toward early spring snowmelt and longer fire seasons. This will accentuate conditions favorable to the occurrence of large wildfires, amplifying the vulnerability the region has experienced since the mid-1980s. The Intergovernmental Panel on Climate Change's consensus range of 1.5° to 5.8°C projected global surface temperature warming by the end of the 21st century is considerably larger than the recent warming of less than 0.9°C observed in spring and summer during recent decades over the western region.

If the average length and intensity of summer drought increases in the Northern Rockies and mountains elsewhere in the western United States, an increased frequency of large wildfires will lead to changes in forest composition and reduced tree densities, thus affecting carbon pools. Current estimates indicate that western U.S. forests are responsible for 20 to 40% of total U.S. carbon sequestration. If wildfire trends continue, at least initially, this biomass burning will result in carbon release, suggesting that the forests of the western United States may become a source of increased atmospheric carbon dioxide rather than a sink, even under a relatively modest temperature-increase scenario. Moreover, a recent study has shown that warmer, longer growing seasons lead to reduced CO_2 uptake in high-elevation forests, particularly during droughts. Hence, the projected regional warming and consequent increase in wildfire activity in the western United States is likely to magnify the threats to human communities and ecosystems, and substantially increase the management challenges in restoring forests and reducing greenhouse gas emissions (Westerling, 2006).

Reducing crown fire potential, fire intensities and improving the ability to suppress wildfires from proposed treatments should help the project area with predicted changes to wildfire from climate change. Preventing widespread stand replacing fires could also reduce impacts to carbon sequestration.

Watershed Activities

The Proposed Action contains the decommissioning (41.21 miles) of and storage (15.49 miles) of roads in the project area to improve watershed conditions. Except for a few road segments, the effects of these actions on wildfire suppression and future fuels management are minimal. Most of these roads are either currently grown over, stacked roads accessing the same area or were originally skid trails or terrace benches and are unusable by a vehicle. Removing these roads from the system will not alter fire management options, the ability to access or suppress future wildfires because they aren’t usable now. Current conditions of these roads would require heavy equipment to remove vegetation in order to make them usable during fire suppression operations. Stored roads would still be available for future fuel management and fire suppression as needed. The forest plan direction specifies all types of fire suppression equipment may be used. This would still be the case after the implementation of Proposed Action. The decommissioning of FR 66 in Ditch Creek will reduce 2 miles of open road access for fire suppression and fuels management within the WUI to the lower portion of this drainage. There is still access available to the general area from the road system located upslope.

Summary of Effects

Implementing the Proposed Action would change fire type across the project area by moving 17,067 acres from crown fire to surface fire, reduce fire intensities to less than 4 feet on 35,067 acres and reduce rates of spread on 5,574 acres. These changes will increase the probability of success during initial attack while improving firefighter safety and fire manager's ability to follow Forest Plan direction requiring protection of values at risk with prompt, aggressive control of wildfires. The Proposed Action would implement recommendations from the Bitterroot Community Wildfire Protection Plan by reducing fuels and changing fire behavior in priority 1 and 3 areas. The Proposed Action would move the project area towards meeting the three National Cohesive Strategy goals (restore & maintain landscapes, fire adapted communities & wildfire response). Reducing crown fire potential in warm dry forest types and restoring fire on the landscape would move conditions closer to the representative fire regimes, allowing the landscape to be more resilient to fire disturbances. By reducing fuels and changing fire behavior within the WUI and community protection zone, the Proposed Action moves the area closer to the goal of making fire adapted communities resilient to loss from wildfire. Lastly, these changes will improve wildfire response by providing less hazardous conditions for firefighters (reduced fire intensities, reduced hazard trees), increasing fire management options and success by creating continuous areas with reduced fuel loads and continuity. This will also increase opportunities for allowing natural fire to play its ecological role within the adjacent Selway-Bitterroot, Frank Church River of No Return Wildernesses and Blue Joint Wilderness Study Area. The Proposed Action also responds to the National Fire Plan goals of reducing hazardous fuels to modify current fire behavior.

Overall the effects of the Proposed Action on fuels and fire behavior are beneficial to both the project area and adjacent communities. The anticipated effects of the proposed action would not be significant because the actions will reduce fire behavior lessening the potential negative effects from wildfire on public health and safety, critical values and natural resources within the project area.

Cumulative Effects

The Proposed Action would complement other Forest Service fuels reduction treatments within and adjacent to the project area around the West Fork community. Relevant recent past, current, and reasonably foreseeable future actions adjacent to this area are the Lower West Fork, School Point Ecoburn, Soda Springs Ecoburn, Upper Nez Ecoburn and the Piquett Creek project. Some of these projects have been completed, others are still in the process of finishing up planned prescribed fire treatments and Piquett Creek is just starting implementation. Modeling shows these previously completed treatments have reduced crown fire potential within the WUI and low severity fire regimes adjacent to private lands. These projects have or will provide more favorable conditions during fire suppression in those areas.

Some private land owners have taken the initiative to reduce fuels on their own or through contract resources partially funded by the RC&D grant program. This has mostly involved thinning small trees or removing dead and dying trees followed by pile burning of the slash. These actions have improved conditions within the home ignition zone for some individual structures but the majority are still at high risk (wildfirerisk.org, MTDNRC, 2020). The exact location and amount of private land fuel reduction treatments are unknown. These actions will have a beneficial effect on individual structure survivability during a wildlife.

Collectively, past and ongoing projects, wildfire disturbances, combined with the treatments of the proposed action would reduce surface, ladder, and crown fuels that will increase the acres of surface fire and reduce fire intensities on a larger portion of the WUI. Changes from past projects, disturbances and the Mud Creek proposed action within the project area are reflected in the proposed action fire behavior results. The changes in fire type, intensities and reduced fuels will improve firefighter and public safety, increase the probability of success during fire suppression, increase fire management options and provide improved conditions for the protection of values at risk. The treatments will also create stand and landscape conditions representative of historic fire regimes of the area. This will reduce the potential for loss of key ecosystem components and reduce the potential severity of future wildfires.

The cumulative effect of past, current and future treatments and disturbances would improve forest resilience to natural disturbances, distribute beneficial fire effects on the landscape, move areas towards desired vegetation and fuel conditions and reduce the risk from wildfire to firefighters and the public. National Forest System lands, and adjacent private lands would have a reduced likelihood of negative effects from large-scale severe wildfires. Cumulative effects would result in increased acres with vegetation conditions that have a low departure from historic fire regimes. Cumulatively, these effects would complement the goals for fire and fuels management of reducing fire intensity and crown fire in the WUI, CPZ and low severity fire regimes. Past fires have had an effect on the whole valley and they will probably continue in the future. Cumulatively, there would be a reduced impact from future wildfire in this area by having less negative fire effects on values at risk should a wildfire occur. This would also improve the ability for firefighters to suppress unwanted wildfire in the WUI or community protection zone. The cumulative changes to fuel and fire behavior conditions within the area will also increase the opportunity for allowing natural fire to play its ecological role within the adjacent Selway-Bitterroot, Frank Church River of No Return Wildernesses and Blue Joint Wilderness Study Area.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Refer to the Regulatory Framework within the Affected Environment section for compliance with specific laws policies, regulations and plans. Also refer to the EA, appendices A and B for information about Forest Plan consistency. Fire suppression activities would still occur within the project area to protect timber, wildlife habitat, visuals and private property as directed by the Forest Plan.

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